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ON STRIKES.

HITHERTO we have refrained from touching upon a topic which scarcely comes within the province of a scientific journal, but the letter which appears in our correspondence columns from the Secretary of the India Rubber, Gutta Percha, and Telegraph Works Company, may be made the peg upon which to hang a few remarks. Apparently the horny-handed sons of toil go on with their daily labours for lengthy periods in a perfectly happy frame of mind and quite contented with their lot in life, until somebody, who has nothing in common with those he stirs up, interposes between employer and man, and tells the latter that he must henceforth consider himself the *one* factor in our industrial system, and that our well-being depends upon him alone. The great strike of the London dock labourers, now happily at an end, has been the means of spreading broadcast the wave of discontent throughout the land, and no sooner have terms been arranged between employers of labour and their workmen in one branch of industry, than another has to face the same difficulty. We scarcely expected that the electrical trades would have felt the evil effects of the teaching of Mr. Burns and his allies, but so it is, and the Telegraph Construction and Maintenance Company first, and now Silvertown, have each had a painful experience of what professional agitators can accomplish when dealing with a class of society unable to think for itself what is best for its own good. On behalf of the men employed in the Silvertown works it is held that they are simply underpaid slaves; Mr. Tyler, on the other hand, asserts that the company's labourers are remunerated on a scale which compares favourably with the rate of pay for similar work in any part of England. On this point we will leave our readers to judge for themselves, as also upon a personal matter connected with the electric lighting department, where Mr. W. Gray is publicly taxed with being too autocratic in his dealings with those under him. The strike *per se* seems to have been carried out on similar lines to that in the docks. In each case a few discontented individuals commenced the disturbance, but while the Docks proprietors refused to concede the demands of the men, Mr. Gray, on the contrary, made an offer which was accepted and the labourers resumed work. Thereupon five other petitions from other departments for an advance in wages came following in, and these were met in what was probably considered an eminently practical manner, Mr. Gray calling a meeting of all the hands and informing them that the advance he gave the yard labourers he would take back, and that the work must be done at the old prices, or else the yard labourers might all go out. A notice was issued the same evening to the effect that all men not satisfied might go out also.

The upshot of the affair is shown in the last paragraph of Mr. Tyler's communication, which means that at least £2,400 per week, if we take the average of wages at about 30s., is being lost to the little colony of Silvertown, and how long this deplorable deadlock will continue we are not in a position to say. The privations to which the wives and families of these misguided beings will be exposed would touch a sympathetic chord in a heart of adamant; but why sentimentalists, who do not generally show their appreciation of the British workman in the desperate straits to which he is so often reduced through his own stupidity by according him anything of a more substantial nature than sentiment, should look upon strikers as martyrs to a worthy cause is more than we can understand. If men were less selfish and would only turn over in their own minds the positions often occupied by their employers during the continuance of a large contract, we should come to a much better relationship between capital and labour. The obtaining of a contract has on various occasions been the pretext for a demand for higher wages, the thoughts of the easily led workman going no farther than the bare fact of an order coming in. The chances are that the master may make a dead loss of several thousand pounds by the time the work is out of hand, and this through no fault in estimating, but from a combination of circumstances which were quite impossible to foresee. Nevertheless, the sons of toil get their weekly wage all the same, and brood over the belief that, while they are working for what they call just enough to keep body and soul together, the master is rolling in wealth. Then, again, let us consider the workman without reference to the employer at all. We assume that, in accordance with the law of supply and demand, a man is in receipt of £1 per week, and, as a technical contemporary aptly put it during the dock strike, he requests an advance in his wage of 5 per cent. Perhaps before this is complied with he has "been out" for three weeks and lost therefore just £3, assuming that no outside help comes to him. He then resumes his employment at one guinea per week, and at the enhanced rate of pay it takes more than twelve months before he can recoup himself for the loss incurred during his three weeks of idleness. More than this, he may have suffered not merely through the non-receipt of a weekly wage, but he has probably found it necessary to part with sundry household articles which have to be again replaced. When the strike of a numerous class such as the dockers is followed by that of bakers, tailors, coal carriers, and the like, it stands to reason that the necessaries of life, at least for a time, are correspondingly raised in price, so it is very questionable whether 20 per cent. advance in a workman's pay means anything like such an elevation of his worldly position.

The sentimentalists, again, deplore the degraded condition in which the labourer spends his life. They forget that he, to a great extent, is master of his own fortunes, or misfortunes if this term is preferable to the ultra tender-hearted. All classes of society have a certain standard of comfort, and the labourer, generally speaking, has little or no ambition to soar above the particular kind of existence which has been meted out to him by Dame Fortune. The poor City clerk with his 30s. per week, and who oftentimes has to devote longer hours to his manifold duties than falls to the lot of the luckless British workman, is in comparatively worse straits, for he has to dress like a gentleman, live in a genteel neighbourhood, and keep up an appearance without which he could not hope to secure a position in a merchant's office. From all these unwritten but necessary rules of deportment, the labourer, while keeping himself, if he chooses, eminently respectable, is free.

So long, however, as men are found ready to listen to the utterances of such professional agitators as Mr. John Burns and his disciples, whose superior education and gift of speech, such as it is, enables them to lead thousands of misguided individuals by the nose, and who take good care to place before their dupes only one side of the capital and labour question, so long will these disastrous ruptures between master and man occur, their frequency being determined by the sweet will of the fomenters of the mischief. And just here we think that the employers of labour are very much to blame, for while statements which are more often than not without a shadow of foundation, and sometimes absolutely false, are placed before the toilers as facts, no effort is made by the capitalists to controvert or place another explanation upon the wild utterances of the unscrupulous demagogues who pose as benefactors to poor humanity. These mischief makers have, as a rule, nothing to lose and everything to gain by instigating others to deeds they would not otherwise have dreamt of.

Why should such a statement as the following, which relates to the Silvertown Company, be allowed to inflame the minds of men who are not prone to reason: "Out of this slave-driving and miserable pay of 3½d. to 4½d. per hour, on which men have to support wives and families, the firm makes a profit of £160,000 yearly."

Surely the very fact that such a profit is made must, to a reasonable being, be the most convincing sign that the company is in a prosperous and flourishing condition. If the profits were *nil*, how long do these poor demented creatures, who have thought fit to turn out, imagine the works would be carried on? And if the shareholders chose to put thousands of pounds into a concern which may or may not be successful, have they not a right to receive a small percentage of profit for the great stake which is entailed, and does not the fact of there being found capitalists ready to risk their money in this manufacturing business constitute the *raison d'être* of the Silvertown *employés* very existence? The Silvertown directors are not more hard-hearted than other employers of labour; in fact, in their private capacity, they are probably eminently charitable, but they have no right to administer the affairs of their clients and shareholders on any other than the ordinary economic principles. It is no part of their duty to pay 6d. per hour for unskilled labour when the market price is less; but it is certainly their right course to resist the demand until it has been clearly shown that the labour they sought was unattainable at the lower figure.

Could workmen only be prevailed upon to consider the difficulties with which a manager has to contend in the conduct of a gigantic hive of industry such as the famous India-Rubber and Gutta-Percha works, they would be less prone to throw up their means of livelihood in a moment of mental aberration, for it is nothing else. Competition, English and foreign, perhaps an obstinate board of directors to cope with, the buying of material in the cheapest market, the incessant watching of prices, the fine cutting of estimates in order to secure work, sometimes only to keep the machines going without a penny of profit; all these go to make a work's manager's life the reverse of a happy one. When men are once settled in permanent employment, their object should be to co-operate with the master, in order that work may be constantly coming in, and not to render all his efforts futile by thwarting him, perhaps at the very moment when the prosperity of everybody concerned is likely to be at its height. They should remember that they are paid for their labour in accordance with what they do; of responsibility, which is the hardest thing of all to bear, they have none.

If these men could have brought before them the masterly address of Mr. Norwood to the proprietors of the London and St. Katharine Docks Company, we firmly believe that a feeling would be produced in their minds which had not previously existed there, and the evils of strikes would be forcibly brought home to them. They now think only of themselves and the present; the disastrous results of their ill-advised action to many other sections of the community, and what the future has in store for them, form no part of their calculations. No one can dispute the absolute right of the labourer to decline work on terms which to him seem unsatisfactory, but compulsion should not be exercised upon others who think differently. It may not be inappropriate to introduce here the opinion of a daily contemporary, with whose remarks every well regulated mind will agree:—"A wider question still is whether the public, under the influence of its amiable sympathy with the Dockers, has been wise to play into the hands of the agitators, and to afford able and unscrupulous demagogues like Mr. Burns so instructive an object lesson. Was it prudent to show these gentlemen that almost anything can be obtained by skilfully playing at once upon the fears and the good nature of the well-to-do classes? Is it likely to tend to the security of industry or to the prosperity of the country, for employers and capitalists to know that they may be at any moment at the mercy of a few professional wire-pullers, who are able to declare that if their demands are not conceded they will cause the greatest inconvenience to the whole community? The lesson, at any rate, has been taught and learned; and it is far from improbable that the forced surrender of the Dock Companies will be followed by a long series of disastrous industrial struggles, which, in the end, will damage no class so much as that of the labourers themselves."

Such scenes as we have recently witnessed in and around London would not have been tolerated for a day in St. Petersburgh, Berlin, or Vienna; but England is fortunately, so we have been taught to think, a free country, and the pretensions of labour can be carried to an extreme. Trade disputes should be settled between the parties fighting for their rights, and no one would desire to see Government interfere with either side; but employers are too often heavily handicapped by hostile public opinion, formed in ignorance of the merits of the case, and against which they have to contend. Is it too much to hope that legislation can, within a reasonable time, be brought to bear upon these trade disputes, and, at least, put down intimidation with a firm hand; and that all disagreements shall be submitted to arbitration, work in the meantime to go on unchecked while settlements are pending?

THE recent gale has of course produced the usual results as regards the telegraphic system of this country, that is to say, in many cases a complete cessation of communication has taken place. Who is to blame for this? Not the Post Office, for the department is prepared at any time to lay down a system of underground circuits provided the order is given, and the necessary funds are furnished for the purpose. It is for the public to stir in the matter through their representatives in Parliament, and the sooner it is done the better. Surely the Chambers of Commerce are sufficiently strong to press the matter forward. The inconvenience produced by the breakdown must have been very great to the commercial world, and has caused a great deal of grumbling, but grumbling without action is, it is needless to say, useless, and we are only surprised that such an important matter has not received the attention it deserves. For an expenditure of £6,000,000 we believe all the main trunk wires could be placed below ground, and, although the sum may be a large one, the nation can well afford to expend it, and it ought to do so.

WE hear that a syndicate for the promotion of a fast-speed telegraph system is at present in London exhibiting the apparatus; it is claimed that 500 words per minute could be obtained through an Atlantic cable. The apparatus includes a dynamo, a steam engine, and an induction coil giving a *continuous two inch* spark. How any telegraph inventor, who has common sense, could suppose that such a potential would be permitted or could be used on a cable is surprising. The idea that such a high speed as that named could be obtained through a cable is perfectly childish; we are quite certain that no proper experiment could have been made to prove that the apparatus could work, as there is no artifical cable that would carry such a high potential without "sparking across" taking place. Some few years ago an American fast speed apparatus, which worked at 1,000 words a minute, was tried in this country; this speed was obtained through an ordinary resistance (the usual test of those who know nothing about practical telegraphy), but when the apparatus was connected to an aerial line, 400 miles long, the result was—30 words a minute; the promotors, after this experiment, scuttled back across the water, and subsequently orders came across for several complete sets of Wheatstone fast speed instruments to be shipped to the States.

AT a meeting of the Executive Council of the Edinburgh International Electrical Exhibition of 1890, on Friday last, it was intimated that a committee had been formed for the purpose of interesting the citizens of London in the Exhibition. The Lord Mayor Elect, Sir Henry Isaacs, has agreed to act as president of the London committee and as one of the vice-presidents of the Exhibition. Sir George H. Grubb is to be executive chairman of the London committee, for which offices have been procured at 3, Victoria Street, S.W. Satisfactory progress was intimated with regard to the guarantee fund, which is now close upon the sum fixed by the executive as the minimum, and no difficulty is anticipated in securing a great deal more than that amount. The Lord Provost, magistrates and Town Council of Glasgow have agreed to receive a deputation from the executive committee, the object being to enlist the co-operation and support of the Corporation of Glasgow in arousing the interest of the people in the west of Scotland in the Exhibition.

THE half-yearly meeting of the shareholders in the Commercial Gas Company was held on the 4th October at the Cannon Street Hotel. Mr. George Livesey expressed his conviction that no electric light could touch gas, even for the purpose of lighting the streets; and Sir Robert Rawlinson endorsed that opinion. What funny reading this will be 10 years hence! Poor benighted Livesey!

NOTES ON THE DYNAMOS AT THE PARIS EXHIBITION.

VIII.

THE Desroziers machine exhibited by the Maison Breguet, and illustrated in fig. 1, has been recently brought into prominence on the Continent. It is of the disc type, the armature consisting of a number of flat coils laid on each side of a disc frame of German silver, which is clamped firmly between two half hubs keyed to the driving spindle, and has its rim stiffened by two rings of gun metal. The coils are first laid on cardboard discs, so that on each disc all the radial wires are on one side, and all the circumferential wires on the other. These cardboard discs, with the coils thus laid on, are fixed one on each side of the German silver frame and clamped to it, the coils being next the German silver, and the cardboard outside. When the coils are firmly clamped in position, the cardboard parts covering the radial wires are cut out and taken off, thus leaving all the radial wires of the coils exposed, while by the clamping of the circumferential parts, the coils are securely fastened to the German silver disc. The armature thus built is very thin and light, and the makers assert that it is at the same time sufficiently strong and rigid. We are unable to give particulars of the exact method of securing the coils to the disc of German silver, for beyond the general statement that the coils are clamped on, Messrs. Breguet keep the manufacturing details a secret. In reply to a question as to whether Foucault currents were generated in the disc, we were informed that they had been eliminated by making the metal very thin, and giving it a particular shape. Our readers may guess from this that there are openings in the disc of such shape and size that the electromotive forces induced in the parts remaining are in opposite directions, which thus prevent the flow of local currents. It is claimed that a larger density of current can be employed in the conductors of the armature, since there is very good ventilation and no heating from the presence of an iron core; at the same time, it should be mentioned that the resistance of the armature in machines of the Desroziers class is somewhat greater than in those of ordinary type. The magnets are placed on each side of the armature, the poles being alternately N and S in a circle, and the N of one circle facing the S of the other. In the 14,400 watts machine exhibited there are six magnets on each side, the poles having extension pieces which face each other and leave an opening of from $\frac{5}{8}$ inch to $\frac{3}{4}$ inch for the armature. This machine runs at 200 revolutions per minute, and the current is collected by two sets of three brushes, placed 60° apart on a Gramme commutator having brass segments, the armature coils being therefore cross connected. In fig. 2 we show the directly driven combination of engine and Desroziers dynamo which is supplied for ship lighting. Several other forms of machine are exhibited, but for the present the Desroziers seems to be the type most pushed by the firm.

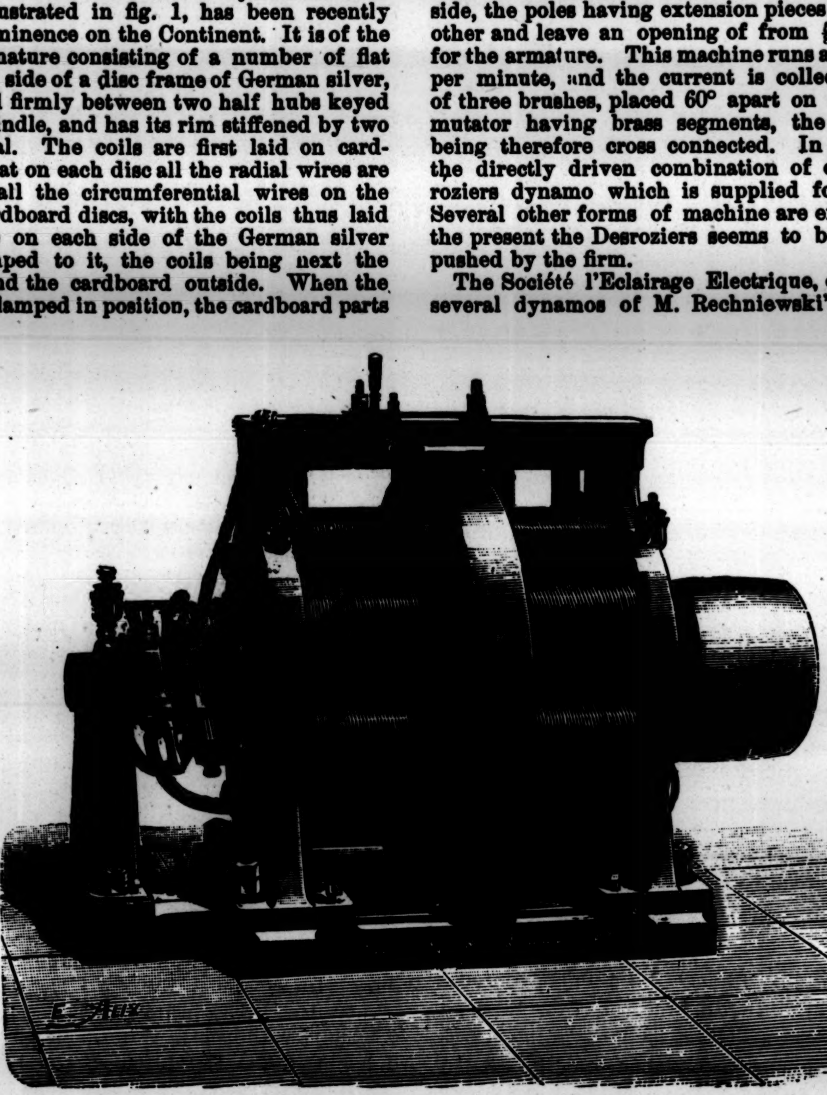

FIG. 1.

The Société l'Eclairage Electrique, of Paris, exhibit several dynamos of M. Rechniewski's design, one of which is shown in fig. 3. The armature core is built up of discs of soft iron ·024 inch thick separated by varnished paper. These discs have Pacinotti teeth on their exterior, between which when they are laid together, the coils are wound Siemens fashion; they are carried upon a central bush of gun metal keyed to the shaft, this bush having twisted arms inside the central opening in the core, by which a current of air is caused to circulate through the interior of the armature. The field magnet is of the single horseshoe upright pattern, but differs from other machines in being built up of thin plates of wrought iron separated by paper, a construction adopted to prevent the armature projections causing heating in the magnet. The magnet is fixed on a cast iron bedplate, on which are also supported the brackets which carry the armature. The type shown in the figure is made in sizes up to 25,000 watts. Above this the machines are constructed with multipolar fields and Gramme armatures. As these present no specially novel feature other than that the magnets are built up as described, we need not describe them farther.

Amongst the odds and ends we noticed a directly-attached combination of a Brotherhood engine and a Victoria dynamo with overhung armature and outside commutator. Messrs. Escher, Wyss & Co., of Zurich, exhibit a two-pole drum-wound dynamo of the Lahmeyer type, coupled direct to a jet wheel. Messrs. Buffaud & Robatel, of Lyons, show a centrifugal sugar machine, with an electro-motor for driving it, attached direct to the vertical spindle. Messrs. Aveling and Porter show a single cylinder portable and traction engine, having a Victoria dynamo mounted above the boiler on a wrought iron saddle, the machine being driven by a cog-wheel on the crank shaft, the wheel having teeth of red fibre, gearing into a gun metal pinion on the dynamo.

A comparison of Continental and American dynamos with those of English design has doubtless been made by our readers as these articles have been perused. As regards the first, one is struck with the number of multipolar machines of small size, engineers on the Continent looking with more favour on this type than we do. Electrically, multipolar and bipolar machines present no difference, and the decision as to which shall be adopted is mostly a manufacturer's question, inasmuch as when other things are equal, the decision lies generally in favour of the least costly to make. To the case of large dynamos these remarks do not apply as beyond a certain size a multipolar machine is in many respects preferable. Some neat arrangements of brush holder gear will not have failed to attract attention, with other little details which add to the look and finish of machines. The extensive use of cast iron for field magnets will doubtless have been observed.

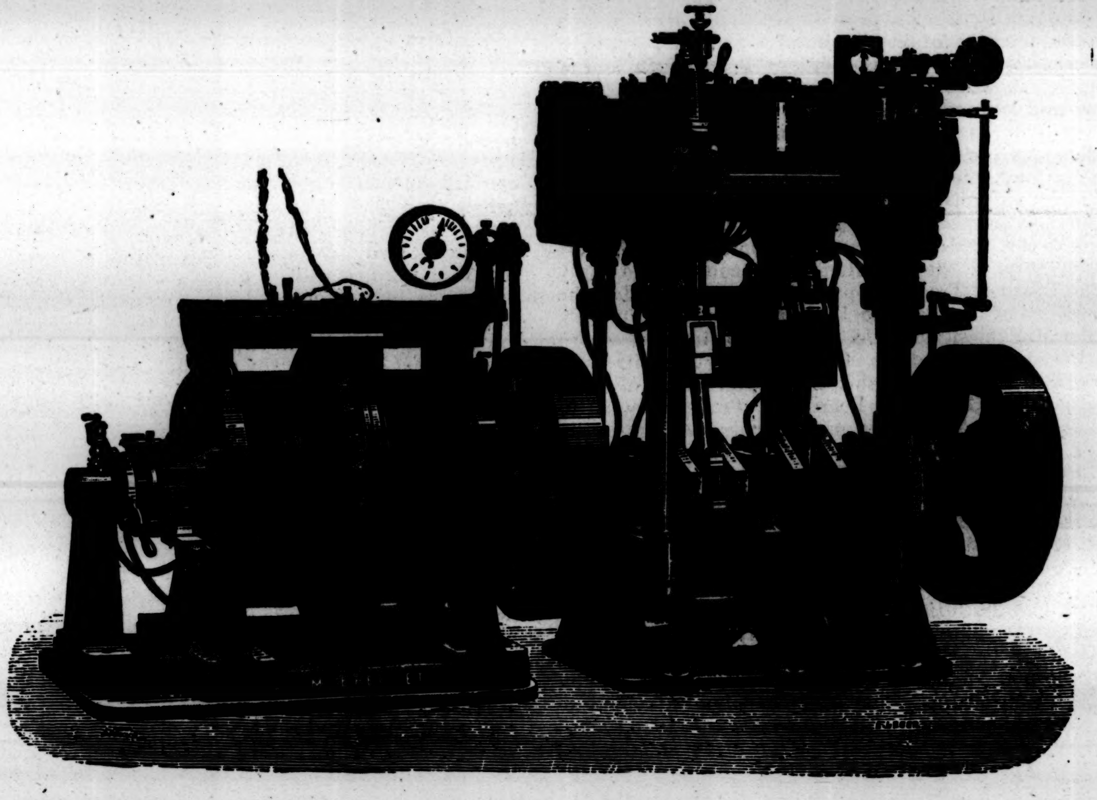

FIG. 2.

Though the designs are many and varied, it cannot be said that in general workmanship and finish there is much difference on the whole between machines of English and foreign make. It is a mistake to judge modern machines of Continental manufacture by the flimsy ill-constructed Grammes which made their appearance here 10 years ago. Since then the foreigner has walked up, and we have in him a keen competitor, and one, moreover, who has the advantage of cheaper labour on his side. The extensive collection of machines at the Exhibition has been useful in showing us what we have to compete against, if it has served no other purpose. Though in another month the great show will be a thing of the past, its influence on our industry will not fail to be widely felt if our manufacturers have learned thoroughly the lesson it had to teach.

W. B. E.

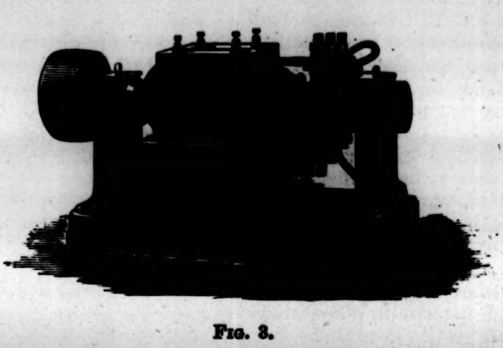

FIG. 3.

Lecture.—An interesting and instructive lecture with, experiments on "electricity and animal magnetism," was delivered by Mr. J. Jerritt, A.I.E.E., of Plymouth, in the Corn Exchange, Chard, on Friday, October 3rd, in aid of the funds of the Taunton Hospital. The hall was filled with an appreciative audience, from six to seven hundred people being present. The telephones exhibited were kindly lent by Mr. Lewis, general manager of the Western Counties and South Wales Telephone Company, Bristol. Some splendid specimens of submarine, electric lighting, and torpedo cables, manufactured by Henley's Telegraph Works, London, were also exhibited.

ELECTRIC LIGHTING AT PORTSMOUTH.

AT length practical steps have been taken with a view to the general introduction of the electric light into the Borough of Portsmouth, which has hitherto, through a variety of reasons, been almost neglected by serious promoters of the new illuminant. The Portsmouth and South Hants Electric Supply Company which was recently registered with a capital of £50,000 in 9,900 ordinary shares of £5 each, and 100 founders' shares of £5, is, however, starting under apparently favourable auspices. The list of directors comprise several prominent townsmen, including Col. Charles Mumby (chairman of the Alverstoke Local Board), chairman; Colonel C. Lanyon Owen, J.P. (director of the Borough of Portsmouth Waterworks Company; Mr. Alexander Ross, C.C. (Ross and Heman), Mr. A. W. White, Mr. W. H. Handley, with Mr. Robert Hammond, managing director of the House-to-House Electric Supply Company.

The company, which will not start operations until the necessary Parliamentary power or the consent of the local authorities has been obtained, has been formed for the purpose of establishing a central station or central stations in the Borough of Portsmouth and at Gosport, at which electricity will be generated on a large and economical scale, and then distributed by means of "mains" or "conductors" placed either underground or overhead as the local authority of each district may determine.

The prospectus which has just been issued says:—"The necessary statutory notices have already been given to the local authorities of Portsmouth and Gosport respectively, of the intention of the company to apply to the Board of Trade for provisional orders under the provisions of the Electric Lighting Acts, 1882 to 1888, authorising the supply of electricity within the Borough of Portsmouth and in Gosport, and the directors have also applied for the consent of each of such local authorities to a Board of Trade licence to enable the company to commence operations forthwith. It is fully anticipated that in Portsmouth and its neighbourhood there will be a wide and rapidly increasing demand for the electric light, and with even a moderate average consumption it is confidently believed that the undertaking will secure a revenue which, after providing for all expenses of production and administration (as also for depreciation of plant, mains, and buildings), will return a substantial dividend to the shareholders. The company's first central station will be erected at Portsmouth on a plan which will permit of the regular and economical expansion of the plant required from time to time to meet the growing demand for the light; as the increase of capital for such purpose will be relatively smaller and the cost of production for the greater output will be proportionally less, it is anticipated that the dividends of the company will grow steadily with the extension of its business. The proposed station will be of similar construction to the central station erected at Kensington by the House-to-House Electric Light Supply Company, Limited, whose engineers were enabled to profit by the practical experience they had previously gained at Eastbourne and Brighton. The Kensington station has elicited the marked approval of many eminent authorities, including Mr. W. H. Preece, F.R.S., chief electrician to the Post Office, and the directors are of opinion that it combines all the advantages to be derived from the most advanced scientific discovery and the selection of the best elements of the various systems of supplying electricity. The company will, however, be as free as the gas companies are to acquire and use any improved apparatus or method that may hereafter be discovered. A contract dated September 27th, 1889, has been entered into between the company of the one part and the House-to-House Electric Light Supply Company, Limited, of the other part, under which that company contracts to erect at Portsmouth a central station with buildings and all incidental works, machinery, and appliances, and to lay down the necessary mains or 'conductors' estimated for the first requirements of the company (the whole being a duplicate, except as to officers, of the House-to-House Company's station at Kensington) for the sum of £25,950, payable, at the option of the directors, either in cash or as to one-half in cash and as to the other half in ordinary shares of the Portsmouth Company, issued as fully paid. No promotion money has been paid nor will be paid by the company, and, after providing for the preliminary expenses attending the formation and registration of the company, the whole of the capital will be available for the purposes of the undertaking."

INDUCTION AND OTHER THINGS.

(Continued from page 377.)

A LARGE share of the space in Dr. Fleming's work has been allotted to descriptions of the work of Joseph Henry and Faraday. It is difficult to say whether this is a good plan or not; we think not. There is nothing in the work of Faraday or Henry that is not now incorporated into modern books, except what has been superseded. If Dr. Fleming's book is to be taken as an encyclopædia article, it should have the historical portions picked out and put together at the beginning, where they could be skipped at once. It is supposed to be the proper thing for every electrician to read Faraday's and Cavendish's researches, and now that Dr. Fleming has said so much about Henry, his works will have to be included too. We have read none of them, and do not mean to. If an electrician wishes to become a good original experimenter, he can, of course, gain a great deal from the example of these men; but if he wants knowledge of facts it is not the best way of obtaining it, and the order of discovery is seldom the best order for learning. This is not said through any want of respect for the giants of the past, and that sort of thing; but people are apt to waste a great deal of valuable time through a sort of hero worship. If a man wants to study, say, Ethics, he is told to read the works of a lot of ancient writers. A large number of young men spend a great deal of time in learning a dead language or two on purpose to drink in the wisdom of the ancients quite pure, but generally stop after using a great deal of good time, before they have begun to taste. Now whatever we may privately think, it might be treason to say that any modern philosophers have as great minds as the old Greeks; but we will say that though a writer of a modern text-book may have no ability at all in comparison with, say, Aristotle, Plato, or Socrates, he probably knows much more than the three of these somewhat prolix and mystifying writers put together. Though this veneration for the past may have great influence in Theology, Ethics, Law, Metaphysics, and in fact all the departments of knowledge of a foggy kind, it should be studiously kept out of Science. No chemist would think of reading up old chemistry books. It is the business of writers of text-books to extract all that is worth keeping from old books and papers.

Some time ago Dr. Fleming divided electrical engineers into two classes; those who could not get beyond Ohm's law, and those who could think of alternating currents. We would go further than this, and would sub-divide the last class into those who try to deal with alternating currents as they really are, and those who assume the simple sine law. The latter should be apprehended under 1 and 2 Vict. cap. 38, or whatever it is, and should be accused of making their data fit their calculations; they should then be convicted of pure mathematics, and locked up with vagrants and tramps and other useless members of society. Finally they should be condemned to the last penalty of breaking the shunt circuit of a big dynamo through their bodies.

A great deal of Dr. Fleming's book is useless to practical engineers, because it depends on unwarrantable assumptions. He points out that the variation of permeability and the magnetic hysteresis in a transformer core will alter the character of the secondary curve, even if the primary is a curve of sines. A very small extension of these ideas will show that there is nothing in a dynamo to make it give a curve of sines. Even if it gives an approximately sinoidal curve at no load, it would not at full load. The departure may be small or great, but no one knows to what errors such assumptions may lead. As we said in a recent review of a book by Mr. Blakesley, this sort of treatment may be useful to get rough results, but that is all that can be said for it. It is usual to have recourse to Fourier's theorem at this stage of the argument; and Dr. Fleming, of course, points out its exceedingly great value and convenience, and then makes no use of it whatever. We do not here deny the value of Fourier's theorem in other branches of physics, we merely say it is no use in alternating current work. Given a periodic function, there is no difficulty in splitting it up; but if you have the curve you do not want it split up. If you have not got the curve, Fourier's theorem will not help you to get it from a dynamometer reading. This part of the book, like a great many other parts, may have a special interest for the mathematical student. Dr. Fleming is a remarkably clear writer. No exact degree of mathematical knowledge on the reader's part is assumed; and some parts require a knowledge that would make other parts very elementary. Probably the best rule is that followed by Dr. Fleming, of explaining everything as clearly as possible, using advanced mathematics only where simple are ineffectual. In one or two places he refers to mathematical text-books in which the particular processes adopted by him are to be found. This is an admirable plan, and might be very much extended. Many people find mathematical books very hard reading, and much prefer to get their mathematics combined with physical meanings by reading science with purely mathematical books as commentaries. While on the subject of making sine curves with cylinders cut obliquely, Dr. Fleming might have added Clifford's method of splitting up a given curve into a Fourier's series. Written more clearly, it might be interesting to many.

The term "impedance," as defined by Dr. Fleming, has no meaning in practical engineering, because it assumes harmonic current variation. A choking coil, as explained by Dr. Fleming, modifies the current curve, even if the electromotive force curve is sinoidal. As Dr. Fleming also mentions, L may be given three meanings when there is iron in the coil. The result of this is that to talk of the impedance of a choking coil conveys no meaning. Even if "effective resistance" had been adopted we should have had a loose and unscientific term thrust upon us, as the effective or apparent resistance depends on what is done with the coil. In old days people used to talk of the apparent resistance of a charging secondary battery, or of a motor; but they soon got clearer ideas, and understood that they were dealing with a resistance and a back electromotive force acting simultaneously. In alternating current work we are passing through the same stage. Very soon electricians will think of alternating circuits as having resistance and giving a back electromotive force, instead of confusing the things together. At present Dr. Fleming and a few others talk of "ohmic" resistance to distinguish resistance from the relation between the back electromotive force and the current. The expression "ohmic resistance" is absurd, else, as a common sense American remarked, work is the product of the poundic mass by the footic length.

The discussion raised by Mr. Sumpner as to the three definitions of the coefficient of self-induction of a circuit which magnetises iron are interesting. It is questionable whether the term coefficient can be rightly used here at all, as it would merely mean a division by the current in use at the particular instant and in the particular case under discussion. But, leaving out the question of the coefficient, how are we to define the self-induction of an electro-magnet with a given number of ampère turns current in its coils? The third way is to consider the energy stored up; but we do not know whether we are to measure the energy that was absorbed in raising the current to that value, or that would be got out of the electric circuit on reducing the current to zero. There is a difference in the case of an electro-magnet. The second method proposed is to measure the whole induction through the circuit. This also depends partly on the past history of the iron. Neither of these definitions is of scientific importance, as no one wants to make calculations about such things, and they are obviously of no practical value. According to the first definition the self-induction is measured by the back electromotive force as the current increases. This is the idea most people have of self-induction, and in practical work it is the only one of any use. In practice, however, people never want to measure self-induction. There is a sort of idea afloat that when the benighted practical man is better educated he will measure the coefficient of self-induction of transformers, dynamo armatures, and mains; but he could not obtain any useful information by such an attempt.

Dr. Fleming uses the secohm as the unit of self-induction. In some ways we are sorry this name was given up, as Profs. Ayrton and Perry had done so much in connection with the measurement of self-induction that their name might have been kept. Like volt-ampère and volt-coulomb, it was a compound word and thus did not really fit the system of units well. The name now adopted is the "quad." This is not the name of any electrician, and it represents a length which is not a round number of metres, and it suggests that self-induction and length are the same thing, a matter on which we will have more to say presently. Before any unit of work was in use, and while people used the watt as a unit of energy a contraction of volt-coulomb was proposed in this journal. The vomb was to be the unit of energy, and instead of Greek affixes being used, we were to have the vomboon and vombling. Instead of this the joule was put into circulation, and there is no settled way of pronouncing it yet. The coefficient of self-induction should certainly have been called after some one; and why should Poggendorff be omitted? We frequently use the whole name when we wish to express ourselves strongly, or use what a young friend calls bad grammar; but we ought to have the practical unit of self-induction called the pogg. The multiple and sub-multiple would be, following old English practice, the poggoon and the pogglet.

The main subject, according to the title of Dr. Fleming's book, is transformers; but the practical and descriptive part will be in the second volume, which we hope may be soon published. We do not follow all of the statements as regards the efficiency of transformers, and fear that some are inaccurate. The loss in a converter may be divided into the loss in the copper, which can be got accurately by multiplying the resistance of each coil by the square of the effective current in it, and the loss in the iron core. The magnetising current, that is the primary current when there is no secondary current, is practically a quarter of a period behind the primary electromotive force, so the power spent in the copper by it may be taken as independent of the load on the transformer. As the loss in the core and the loss in the copper, due to the magnetising current, are constant, and as the rest of the loss in the copper varies as the square of the current, it is obvious that a given transformer gives its highest efficiency when the loss in the iron, together with the loss in the copper due to the magnetising current, is equal to the rest of the loss in the copper. In an ordinary closed circuit transformer the product of the square of the effective magnetising current and the resistance of the primary is inappreciable; so the highest efficiency is when the loss in copper is equal to the loss of iron. Similarly, in a given dynamo, the highest efficiency is when the loss in the armature and series coil is equal to the constant losses in the machine. The problem of finding the highest efficiency of a given transformer is quite different from that of finding the most efficient transformer for a given output, and the last is the important question in practice. The examples given of efficiencies from practical tests are useless, as the dimensions of the transformers are not given, and the results are not correct. The first set are from experiments on a Kapp and Snell transformer made by Prof. Ayrton's students. The resistances of the coils are not given, but as the copper loss varies as the square of the load, and the iron loss is constant, any two sets of readings will admit of their separation. But no pairs of readings give the same result. The resistances so calculated vary considerably; but as Prof. Ayrton elsewhere gives 0·7 and ·14 as the resistances, presumably of the same transformer, we may work from those. The loss in iron then comes out 53·2, 77·6, 79·3, 30·4, and 47·9 watts. The variation in these numbers is 160 per cent. of the smallest value, and a rough guess would be nearer than that. The determination of the loss in the copper by a calorimeter is unnecessary, the difficulty is to determine the iron loss accurately. The experiments go to shew that this type of transformer has a high efficiency, which we should expect, but they do not shew how high.

The tests of Gaulard and Gibbs transformers next given are valueless. The efficiency is determined by means of the angle of lag method. The loss in iron, which is the only quantity there is any difficulty in measuring, is assumed at 2½ per cent. The author points out that this is too small, but there is no object in the experiment if the iron loss is assumed, as the copper loss can be obtained directly without any unwarrantable assumptions. The loss in iron is not a percentage, but a constant, so that such figures as 27 per cent. efficiency at ·2 ampères and 77 volts secondary are absurd. Adding on the 2½ per cent. to get the losses in copper only, the efficiencies given become absurd. The loss in copper then comes out ½ per cent., with six lamps on the secondary. With 15 lamps on it is a trifle less, in spite of the transformer taking the astounding magnetising current of 41·8 ampères under 60 volts. The copper resistances are given, and the efficiences, assuming no loss in iron can be got. Thus the full load efficiency of 94·3 per cent. is too high. The copper loss alone is 94. Taking, say 5 per cent. of full load for iron loss, the full load efficiency that is on 23 lamps comes out 89 per cent. The efficiency at six lamps then comes out 71·5 instead of 97. On a load of three voracious lamps, which take 630 watts between them, the efficiency given is 93·74 per cent. It comes out 81·5. The efficiency of 27·76 at no load, or even when feeding a voltmeter, is incapable of serious discussion. Even with 2½ per cent. of full load as iron loss, it comes out 0·14 per cent. This table of results is rather a satire on the use of curve of sine assumptions.

Prof. Galileo Ferraris's experiments and researches are quoted and treated at great length. He does not give the current in ampères, or the electromotive forces in volts; but as he gives the resistances we can work out the losses in arbitrary measure. On page 301 is given a table of measurements, and on page 322 a table of calculated efficiencies. From these we can calculate the loss in iron. The dynamo used ran at approximately constant speed, but its electromotive force appears to have fallen enormously with the load. Experiment No. 1, with an output of 51·7 and an E.M.F. of 4·6, gives an iron loss of — 50·7. No. 2, with an output of 232 and an E.M.F. of 21·4, gives an iron loss of — 28·9. No 6, with an output of 467 and an E.M.F. of 57, gives an iron loss of 24·8; and No. 12, with output 320 and E.M.F. 68, has loss of 59·5. Of course, a transformer whose core acts as a freezing mixture is of enormous value. These experiments do not appear to have been made with the view of practical utility, as no one would test a transformer with its secondary electromotive force varying 1,600 per cent. Its object must have been to show the great value of the curve of sine assumption in transformer work. Its value is apparently — 50·7. The work of Prof. Ferraris is always regarded as a model research, and treated with great respect; it is therefore with some hesitation that we make these remarks. It is possible we may have misunderstood some of the readings. We hope so, but cannot see where there is room for a mistake.

The present volume is not supposed to deal with transformers in practice, and we hope the author will avoid inserting published results without critical examination in the second part of his work.

(*To be continued.*)

THE ELECTRIC LIGHT COMPETITION AT INNSBRUCK.

[FROM A CORRESPONDENT.]

THE city of Innsbruck, the capital of Tyrol, possesses, since August 17th, electrical works, established by the Augsburg Company for Gas Industry (who own the Innsbruck gas works) in conjunction with Messrs. Ganz & Co., of Buda Pesth.

The central electrical station is situate on an eminence near Mühlau, at a distance of about three kilometres from the city, and obtains its motive power from the water of the Wurmbach, which traverses the district of Gemeinsten Arzl and Mühlau previously to falling into the Inn. Before this point the brook is collected at an elevation of 1,000 feet by means of weirs and sluices, so as to produce a considerable fall of 115 metres, yielding more than 600 H.P. In the first place the abundant water-power is used to work two turbines of 150 H.P. each, each of which drives an alternating machine directly connected, at 250 revolutions per minute. The installation therefore begins its activity with a total output of 160,000 watts, but an extension is already in contemplation.

The Innsbruck Electrical Works have been executed on the Zipernowsky-Dèri-Bláthy system of distributing the current with alternating current transformers, in such a manner that the primary current of 2,000 volts at the terminals of the alternating current machine is converted into a secondary current of 100 to 110 volts. The primary leads are carried overhead to a distance of three kilometres from the central station, but in the city itself they branch off into an underground net of cables. Already two hotels, the Anatomical School, the principal Assembly Room and several private establishments have been put in connection.

It must be noticed that the Innsbruck Electrical Works supply current not merely for lighting purposes, but for motive power. For the latter purpose the Ganz alternating current motors are used. Already several subscribers for electric power have come forward (to the extent of 2 to 40 horse-power), and the Innsbruck Electrical Works will be the first installation fitted with alternating current transformers which furnishes its subscribers with current for any purpose (whether for lighting or motive power) by means of one common conductive net.

During the erection of the electrical works, there arose in Innsbruck an agitation in favour of the erection of opposition works and the establishment of a second station within the city, and worked by steam by the firm of Siemens and Halske, was suggested as possible. The agitation was conducted on the large scale; public meetings were held in order to excite among the citizens a feeling unfavourable to the works. The orators of the agitation said that the electrical works had been undertaken by the gas company merely in order to monopolise the entire lighting of the city. Circulars were sent out recommending the citizens, before introducing the electric light, to wait for the erection of the opposition works, and a prospect of very cheap prices was held out on behalf of its promoters.

In this manner a large part of intending subscribers were led to withdraw their support from the Mühla

Works. When, however, the question came up of raising capital for the opposition scheme by means of shares, and as the citizens were invited to a financial participation in the undertaking by an appeal to their self-sacrificing public spirit, there arose a natural hesitation touching the possibility of competing by means of the costly agency of steam, and with works erected within the city against the installation of transformers actuated by inexpensive water power. After the attempt to induce the corporation to participate in the opposition had failed, the plan of raising funds in Innsbruck terminated in a lamentable fiasco.

Such was the position of affairs when then the Innsbruck Electrical Works above described came into operation. However, the ringleaders of the intended opposition were still unwilling to give up their project, and one fine day the local papers contained the surprising intelligence that the Salzburg Electrical Works had resolved to call a general meeting proposing to increase their capital by 200,000 florins, for the purpose of erecting an electrical central station at Innsbruck.

The Salzburg Electrical Works were erected in 1887 by Siemens and Halske, and had been about the middle of this year converted into a company with a capital of 300,000 florins. As to the remunerative character of this undertaking I could not obtain any connected data, but their prospectus, dated March 1st, 1889, gives some interesting intimations on this point. It holds out the prospect of a dividend of 9 per cent. on the basis of an estimate of receipts and expenditure, in which the items for repairs and for paying off the 290,000 florins, at which the works are valued, are not mentioned.

The general meeting above referred to was held on September 14th, about eight shareholders being present, five of whom were directors. It was unanimously resolved to increase the capital for the purpose proposed. Whether the funds requisite for such an increase can be as easily obtained as the unanimous votes is another, and hitherto an unsolved question.

I have just read in the *Neue Tirder Stimmen* that the firm of Siemens and Halske have obtained from the Municipality a concession for an electric installation at Innsbruck, and that the erection of the central station will probably soon be taken in hand. If this installa- is really to be undertaken and worked by the above-named firm without the aid of extraneous capital in the way of shares, then, save the two competing firms, no one can lose by the edifying drama afforded by the competition of two electrical works at Innsbruck. The firm of Siemens and Halske is rich enough to indulge in the luxury of competing with a steam central station against a cheap water-power. The citizens of Innsbruck will certainly be the gainers.

ALTERNATING CURRENT MOTORS—THE EVOLUTION OF A NEW TYPE.[*]

By Lieut. F. JARVIS PATTEN.

ON giving our secretary the title of this paper, it was my purpose to treat the subject in a broader light, and to show the progressive steps in a series of experiments which led eventually to the type of machine that I shall bring to your notice this evening. The recent and urgent claims of other work have rendered such a treatment impossible at the present, and I shall limit the paper to a description of a new alternating current motor, one form of which is shown in the accompanying drawing.

The place that the alternating current electric motor is destined to fill in the industrial arts is familiar to you all, and the various ways known to the scientific world by which such machines may be rendered operative, have been ably considered and elaborately discussed in the Institute papers of the past two years by Prof. Thomson, Dr. Duncan, and Mr. Tesla. We are thus all more or less acquainted with the prominent difficulties of the problem.

My experience in common with that of my predecessors teaches that the alternating current motor has a strong and persistent disposition to stand still, and when persuaded to motion it is apt to be a sort of "go-as-you-please" machine, and asserts its inherent right to turn in either direction indifferently; direction of rotation in some cases being purely a matter of chance. I shall not have much to say about efficiency, as my experiments with large machines are not sufficiently advanced to furnish any reliable data; but I will endeavour to give a general solution of the problem designed to meet the following conditions of practice:—

1. A machine that will start itself independently of the speed of the generator or number of alternations of current per unit of time.
2. A machine that has but one direction of rotation and cannot reverse under any conditions of current alternation.
3. A machine that is not necessarily synchronous with the generator, revolution for revolution.
4. A machine in which reversals of current direction do not produce corresponding reversals of magnetism in any iron part when the machine is in motion at its normal speed and maximum efficiency.
5. A machine of simple form, having an ordinary continuous wound armature revolving in a single or two-pole field.

Referring now to the figures, which are simply diagrams of the circuits and operative parts, we have in fig. 1 an ordinary closed circuit armature shown as a Gramme ring merely for convenience of illustration, the points of the winding intermediate between the eight coils being connected in the usual way to the eight segments or bars of an ordinary Gramme collector, and it may be well in passing to note here the functions of this collector. It is not a commutator in the strict sense of that term, as it does not rectify or re-direct reverse or opposed currents. If the brushes, b^1 and b^2, were held upon the outside wire of the ring, the same results would follow, and the Gramme collector, properly so called, simply transfers the brush contact from point to point of the continuous ring winding. If a source of direct current be interposed between the terminal, A^1 and A^2, current will flow continuously from brush b^1 to b^2 downward through the right and left hand halves of the ring in the direction of the arrows, k^1 and k^2, making, say a south pole in the ring at the upper point, s, and a north pole at the lower point, n. With a continuous current these poles would be continuously maintained, and placed in the magnetic field indicated by N and S, the armature would continuously revolve in the direction indicated by the arrows, K K. If now a source of alternating current be inserted between the terminals, A^1 and A^2, the polarities of the ring would be reversed at each successive alternation of current, and if a direct impulse, indicated by the single arrows, in the external circuit produced the poles, n and s, in the ring, the reverse impulse, indicated by the double arrows, would produce the opposite polarities, n^1 and s^1, at the same points, and the tendency to motion would be reversed if the fields remained the same, but, it will be noted, the motion would be in the same direction still if the fields were also reversed by the same reversal of current. If, however, the fields were maintained constant, as indicated by the large letters N and S, and some device could be contrived by which at each reversal of the alternating current the brushes, b^1 and b^2, could be made to change position, either mechanically or otherwise, then with an alternating current a constant polarity, s and n, would be maintained at the upper and lower points of the ring—for then a direct impulse, starting from A^2 to the right, would enter the ring through the brush, b^1, flowing down both sides in the direction of the arrows, k^1 k^2, out through brush, b^2, and back to the source at A^1. The reverse impulse, indicated by the double arrows, would start from A^1 to the left, going to brush, b^2, and if we now suppose this to have changed places with the brush, b^1, the reverse current would then enter the ring at s, and, flowing down both sides in the direction of the arrows, k^1 and k^2, would leave through n and the brush, b^1, and so back to the source, a^2, maintaining the polarity of the ring the same as before. If the brushes could be thus changed at each alternation, the polarity of the ring would be maintained constant with an alternating current. While, however, it is quite impracticable to thus cause the brushes to change position mechanically at each reversal of the current, it is perfectly feasible to produce the same effect without the mechanical change. The means of accomplishing this result are indicated in fig. 2, which is identical with fig. 1, with a single exception. There are eight coils, as before, and

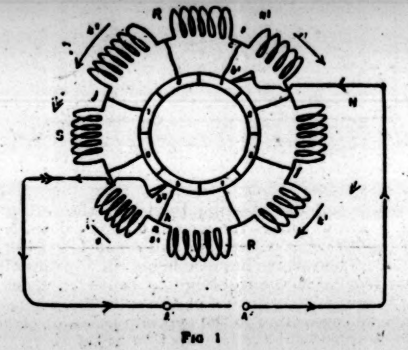

FIG 1

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[*] Read before the American Institute of Electrical Engineers, September 10th, 1889.

eight bars in the collector; the odd numbered bars, 1, 3, 5 and 7, are connected to the same points of the ring as before, *c*, *f*, *h* and *j*, but the even numbered bars, 2, 4, 6, 8, are connected respectively to points of the ring diametrically opposite them, bar 2 to the point *d*, bar 4 to the point *g*, and so on each even numbered bar to a correspondingly opposite point of the winding. If now a source of alternating current be interposed between the terminals, A^1 and A^2, and we make the single supposition that the ring shall turn through an arc of the circumference equal to that covered by one bar of the collector during each alternation of current, we shall still maintain a constant polarity at the upper and lower points of the ring without causing the brushes to change position mechanically.

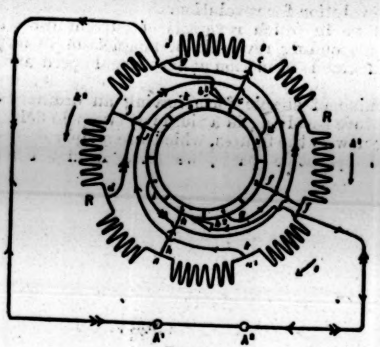


FIG. 2.

Thus a positive impulse starting from A^1 to the left and indicated by single arrows enters the ring at b^1, flows down both sides to *n*, producing the ring polarities *s* and *n* out brush b^2 and back to source at A^2. The reverse impulse being in the opposite direction will start from A^2 to the right, go to brush b^2, which we will now suppose bearing on segment 4 of the collector, whence it will go by the inverse connection to the opposite point, s^1, of the ring, then down both sides in the same direction as before to the point n^1, thence back to the opposite segment 8 out, brush b^1 now bearing on this segment and back to source at A^1.

The reverse currents therefore, under the assumed conditions, are caused to maintain a constant polarity in the ring, so that in a constant field its tendency to motion would always be in the same direction with an alternating current in the armature. It will be further noted that the alternating current is not re-directed or commuted in the strict sense of the word, and we may enunciate the fundamental principle which underlies the construction of this type of machine as follows:—

"The poles of any closed circuit may be maintained constant with an alternating current by causing opposite impulses to traverse the circuit in opposite directions." The direct and inverse connections, shown in fig. 2, have precisely this effect, when, as supposed, a single bar of the collector passes under the brushes at each reversal of current. The connections, *c c*, *d d*, *f f*, &c., in fig. 2 may have any form, and other bars may be interposed between their extremities without affecting in any way their functions as connectors. This step is shown in fig. 3, where another collector

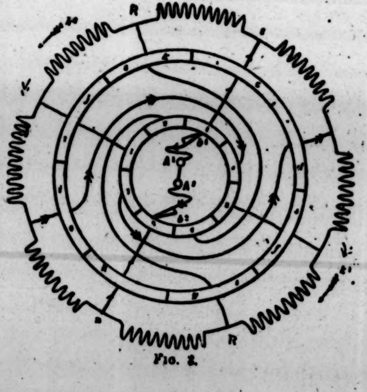


FIG. 3.

bar, 1 *c*, 2 *d*, 3 *f*, &c., is inserted in each of the connections, *c c*, *d d*, &c., of fig. 3, thus making another collector shown outside the first to avoid confusion of the drawing, while for the same reason the source of alternating current, A^1 A^2, is placed inside the inner ring. As the polarities, *s* and *n*, of the ring are maintained constant, as previously described, with an alternating current, and current is constant in direction from *s* downward through the right and left halves of the ring to *n*, so must necessarily any current be constant in direction which is led from brushes through any shunt circuit connected to the segments, 1 *c* and *n*, of the outer collector; a field circuit of constant direction may therefore be shunted from this outside collector. This is shown in fig. 4, in which 12 coils are shown in the ring and 12 bars in each collector connected alternately direct and inverse as before. Tracing now two opposite impulses of current, we have the first indicated by the single arrows from source A^1 to segment 1 of the inner collector, thence to segment 1 of the outer collector, where the current divides, part going down to the right and left hand halves of the ring to *n*, and part out brush b^3 through the field circuit making the poles, N and S, back to brush b^4, segment 7 of outer and segment 7 of inner collector, to the terminal, A^2, of source. If the armature be supposed now in turn through the space covered by one collector bar, the reverse impulse can be traced as follows: Starting at A^2 in the opposite direction to brush b^2 now bearing on segment 8 of the inner collector, thence through the reverse connection to segment 2 of the outer collector, now under brush b^3 where the current divides going part as before down the right and left halves of the ring, making a south pole at s^1 and a north pole at n^1, as before, and the other part out of brush b^3 through the field circuit in the same direction as before, back to brush b^4 now on segment 8 of the outer ring, thence to the reverse connection back to segment 2 of the inner ring, now in bearing with brush b^1, and so returning to the source at A^1. Thus the two impulses of opposite direction have been made to traverse both armature and field circuits in the same direction, we have, therefore, with an alternating current constant armature polarity and constant field polarity, and therefore a constant tendency to motion in the same direction. Not only this, but the further condition is fulfilled that there are no reversals of magnetism in any iron part so long as one bar in the machine, as shown in fig. 4, passes under the brushes at each alternation of current. It remains to show how this is brought about. Referring again to fig. 4, let it be supposed that the first impulse of current did not cause the armature to turn through the arc of the circumference subtended by one segment, but all the brushes still bore on the same segments, as shown in the fig., and the reversals of current continued. By tracing the circuits it will be seen that each reversal of current reverses the polarity of both field and armature, and with either direction of current or rapid reversals there will be a constant tendency to motion always exerted in the same direction.

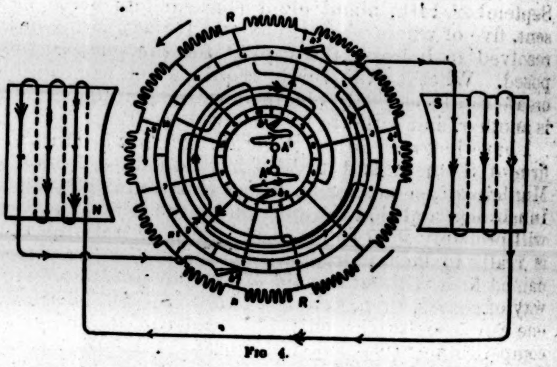


FIG. 4.

The machine under these conditions becomes therefore simply a direct current machine on an alternating current circuit with a constant tendency to start in one direction. Assuming the machine, therefore, self-starting, it will continually gain in speed until the condition is fulfilled of one segment passing the brushes at each alternation, for it then becomes in the broad sense a synchronous alternating motor. The current then produces no reversals of magnetism and there is a true alternating current in the armature circuit, producing, however, no reversal of armature polarity, and a current of constant direction in the field. Under these conditions the motor is self-regulating, moving at a constant speed and with a maximum rotary effort.

It is not, however, essential that one bar should pass the brush at each alternation, as any number may be caused to do this depending upon the speed required and the number of coils upon the armature. This is illustrated in fig. 5, where the complete machine is shown. There are 24 coils in the armature, 24 bars in the outside collector and 32 bars in the inside one, this latter being composed of 24 connecting and eight insulating bars. The connecting bars of the inner ring are numbered to correspond with those of the outer ring around to the right from one to 24; the insulating bars, drawn shaded, separate the others into groups of three. In this machine three segments, 1, 2, 3, in the outer ring, are connected direct to the corresponding segments, 1, 2, 3, of the inner ring, likewise the opposite three, 13, 14, 15 of one ring are connected direct to 13, 14, 15 of the other. The next group of three is connected inversely 4, 5, 6 of the outer ring to the diametrically opposite bars 16, 17 and 18 of the inner, and the corresponding opposite group 16, 17, 18 of the outer ring are likewise connected inversely to the diametrically opposite group 4, 5 and 6 of the inner ring. The remaining segments are connected in the same manner, but the connections are omitted to avoid confusion of the drawing. The operation of the machine is evidently the same as that shown in fig. 4, except that the required conditions are fulfilled in this instance when three bars of the collector pass under the ring at each alternation of the current, and as there are 24 segments arranged in groups of three, the machine, at its normal speed, would make one revolution for every eight alternations of current, and connected in a circuit supplied with 16,000 reversals per minute its nominal speed would be $\frac{16000}{8} = 2,000$ per minute, and with 48 segments arranged in groups of three, its speed would be 1,000 per minute. The blank segments insulating

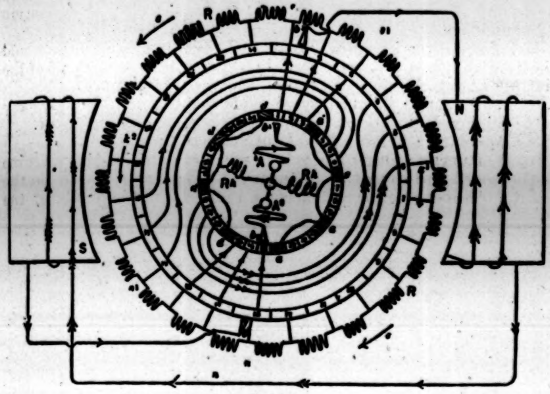


FIG. 5

the groups of the inner ring are connected to the extremities of a rheostat, Rh. Rh., which is enclosed inside the commutator and is designed to offer a path for the alternating current such as there may be, and prevent its absolute rupture at a period of change from one group of segments to the next; they also serve an important purpose in preventing a dangerous short circuit which would be occasioned by the inner brush bridging two groups of segments oppositely connected.

It follows, as a matter of course, as the machine starts as a direct current motor connected in an alternating circuit, rapid reversals of magnetism will at first be produced in all the iron cores, and these should be made of laminated iron to prevent undue loss by heating at the period of starting. The machine, in fact, starts as a direct current motor, and automatically changes to a sort of synchronously alternating motor. When it gains its normal speed at this point it is self-regulating, and its capacity of doing work is a maximum.

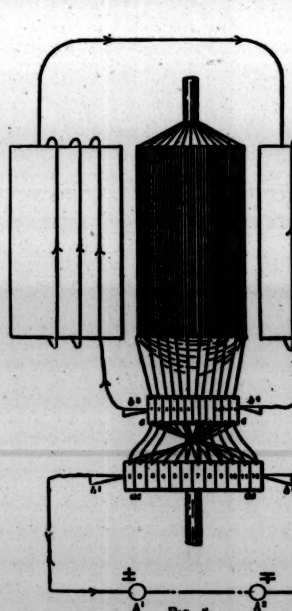


FIG. 6

Fig. 6 shows a plan of the machine as constructed. It consists simply of an ordinary closed circuit armature in a single field; *c c* is the ordinary collector, really a part of the armature circuit, from which the brushes, b^3 b^4, take a current of constant direction to the field shunt; *a c* is the reversely connected commutator, and the brushes, b^1 b^2, bearing upon this commutator are connected to the terminals of the alternating current circuit.

I might add to the paper the fact that the inner commutator, the one which is the ordinary commutator of the Gramme ring winding, does not perform the ordinary functions, as the brushes bearing on this collector require no adjustment, it being merely a rubbing contact from which the shunt field circuit is taken as a derivation to the main circuit of the machine. With that exception, I think the machine is fully explained in the paper.

MR. C. O. MAILLOUX: I would like to ask Lieutenant Patten in regard to the possible presence of sparking—whether it occurs to an injurious extent or not?

Lieutenant PATTEN: The sparking being due to the electromotive force at the point of breaking, it will necessarily occur during the starting of such a machine, and more than ordinarily when it is out of synchronism with the alternating current. At the outset it can be easily seen that the alternating current is liable to be broken at a point where this electromotive force is high, and therefore the sparking would be very violent. I have endeavoured to obviate the trouble due to that cause in the machine—the device is shown in fig. 5. If you will notice the circuits carefully it will be seen that the circuit of the alternating current is never broken. If the brush comes on to one of the dead segments or shaded segments connected with the rheostat before the alternating wave has come to zero, it finds a path which is at first in parallel with the machine circuits, and then becomes a separate path for the alternating current during its change, whether this change begins at a high or low electromotive force. Of course, as the machine starts this may happen at any period of the wave, and the brushes passing over these segments connect with the resistance at the end of the group, and before it has left the group the current is already short-circuited through this rheostat. So that the alternating current always has a path and the sparking will not be excessive, judging from what little experience I have had.

MR. R. S. DOBBIE: I would like to inquire whether the field magnets are laminated, and whether the lamination would be necessary only while the machine was starting up as an alternating current motor or before the synchronism is attained. Another question I would like to ask would be if the maximum torque of a machine is at one-third speed, what comparison is that to the torque of the same machine at full speed when the sychronism is attained?

Lieutenant PATTEN: In answering to the first point I would say that there is no essential reason for laminating the field magnets for any other purpose, but it has been shown by quite conclusive experiments that a laminated machine has a very definite neutral line of field, which makes it simpler and better for taking the direct current shunt for the field from that point without having to arrange to make two sets of brushes movable instead of one set. With respect to the other point, the torque of such a machine depends, of course, entirely on its keeping in synchronism, and the result of the departure from that point is well known to all. That is the limit of the strain that can be exerted. When that is exerted the machine will stop; it will not then continue as a direct current machine.

MR. DOBBIE: My reason for asking that question was to find out if the motor will start on a full load.

Lieut. PATTEN: No; it will not.

MR. LEMUEL WM. SERRELL: I would like to ask how the currents are short-circuited through the rheostat when the ends of the rheostat are connected to the insulator blocks in the commutator?

Lieut. PATTEN: The question is a pertinent one, inasmuch as the term "insulated" was used in the paper. They are not insulated segments in the true sense of the word. They are all connected with each other, and are of conducting material. The mistake is my own entirely in using the word "insulated" in any sense. The insulating segments referred to are the same kind of segments as the others. They are simply other segments not connected to the machine circuits a little narrower than the others.

MR. SERRELL: The shaded portions, as I understood, are insulated blocks, but, as is now explained, the shaded portion indicates a metallic connection separated from the rest of the commutator.

Lieut. PATTEN: No; they are simply segments the same as the others, but are connected to an interior rheostat which is not in the circuit of the machine. I think, as has just been suggested to me, that they should be called "isolating" segments instead of insulating segments. They are segments not connected with the circuit of the machine, but simply to the rheostat, which is shown in the drawing, and this rheostat is intended to take the current at the time the brush leaves the group which is connected with the machine circuits, and so prevents sparking.

MR. H. WARD LEONARD: I would like to inquire whether the interruption of the current in the field is going to occasion any loss of energy, or heating of the field, or lack of efficiency?

Lieut. PATTEN: I might say in reply to that and answer at the same time a good many questions that might be advanced of a kindred nature, that my experiments have been very limited, and that it would require considerable investigation to determine that point definitely. I have no doubt that it does limit the action of the field, but to what degree I do not know. But the current is broken when the machine is in synchronism at a point near its zero value. Of course, at 16,000 alternations per minute, the interruptions are so short that the field could not readily lose its magnetism, but whenever there is a break in the current, there must be some slight loss due to that.

DR. ALLAN V. GARRATT: Another question in regard to the rheostat: Is the resistance of those coils gotten at by experiment, and if so, what relation do they bear to the resistance of the machine itself?

Lieut. Patten: So far I have attempted to make the rheostat simply equal to the resistance of the machine, so that there would be as little change in the strength of the current as possible.

Mr. Mailloux: Is the resistance reactionary or simply dead?

Lieut. Patten: So far the resistance in the commutator is a dead resistance simply. It might theoretically be made to advantage of the reactive kind.

Mr. Mailloux: I should think that a machine of this kind, although it is of great theoretical interest and is an evidence of striking ingenuity, would be open to a defect arising from the fact that the current is a wavy one, no matter how rapid the periodicity is. There is always a very short time when there is no current. We may consider that the magnetising current through the shunt is a succession of waves. Consequently there would be an oscillatory tendency in the magnetism, a tendency to rise and fall with it. If the magnetic core is laminated and of soft iron, I think that it will be able to rise and fall quite readily; in other words, quite rapidly enough to follow the fluctuations of the current. We know that it does so in transformers. Of course, there is a slight reaction in the substance of the iron itself—its "viscosity," due to hysteresis; at the same time it is not sufficiently great to interfere with the rise and fall of the magnetism, and the more perfectly the core is laminated the more rapidly the rise and fall would take place. Also the thinner the laminæ; so that if the magnetic field is made of a very finely divided magnetic medium, and if the rise and fall can take place readily enough, it seems to me that there would be a certain amount of loss in consequence, which would be quite material under certain conditions, and also a certain amount of loss due to the reactions following from mutual induction in the armature itself, because we can see that even when running at synchronism the current in the armature would be a succession of rises and falls, and although the magnetism of the armature is not reversed, yet the current is reversed through the coils, and that is not, perhaps, so disadvantageous as the fact that it is constantly rising and falling at a very rapid rate. I should think that the loss due to mutual induction, particularly in the presence of a magnetic body of permeability and susceptibility, such as the armature core has, would lead to a very important source of loss, and I should not expect that a motor built on that principle would show the efficiency which we might expect from other forms—for instance, as those forms suggested by Leblanc in France and by Mr. Mordey in England.

Lieut. Patten: I have only to say in reply to that that there is one evident misconception about the direction of current in the armature circuit. It is always the same. As to what has been said with reference to the induction due to the rise and fall of current, such loss is contemplated, and it is difficult to make out of an alternating current anything that does not vary. The essential fact, however, is that the current at work is due not only to the maximum and zero values of the electromotive force exerted, but to the current which is the result of the mean electric force, and that is the electromotive force out of which we desire to get the work. The current is of constant direction in the armature circuit, but it rises and falls as has been said, and the loss due to that is contemplated. I do not recall any machine described by Leblanc, except those that he has referred to as Mr. Tesla's and Prof. Thomson's earlier form of motor. Beyond them I do not recall any machine in which these difficulties are not equally present.

Mr. E. P. Clark: I do not think that the rise and fall has very much influence in that, because when the armature is revolving at a high rate of speed, it is the same as a continuous current dynamo. As long as the speed is constant the current will be very nearly the same. There will be very little rise and fall to it, due to the rise and fall of the alternating current.

Lieut. Patten: The current in the field will necessarily be a re-directed current. It would be represented graphically in the form I have drawn on the board (fig. 7). The commutated current at work, or the electromotive force, to speak more strictly, would be cut off at the point a^1, we will say; if the machine is in synchronism at points a^1 and a^2 the interval would be a period of no current. The loss spoken of by Mr. Mailloux will exist during such a slight period of no current whatever, as occurs at this point between here and here. I think that a solid field would not probably give up its magnetism during that short period of time. A closely laminated field might do so.

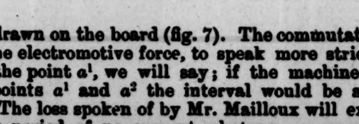


Fig. 7

Mr. Leonard: I should like to ask if you increase the load of the machine without fully loading it, and the load is removed, whether there would not be a tendency to race, or what reason there should be that it would not run away?

Lieut. Patten: The limit of load in such machines is that which is required to throw it out by a full quarter of a period, and this is reduced to a quarter of a group of segments. If the load is lifted off, it cannot, unless the conditions of current change suddenly, go beyond its ordinary synchronous rate.

Mr. Leonard: Can it race?

Lieut. Patten: I think not. The tendency, of course, is if it races to go to the double synchronism. It has to go to the double speed or the quadruple, or else at the single speed at which it is synchronous.

Mr. Mailloux: I do not think that Lieut. Patten has made quite clear the reason that would tend to inhibit the racing tendency, or, in other words, the influence at work to maintain the speed constant when the load is increased or decreased—the exact action which takes place by which the torque is changed.

Lieut. Patten: The action of this machine is not different from that of an ordinary alternating current motor where its maximum electromotive force is exerted when it is in synchronism within a quarter period of that of the generator. If it is overloaded beyond that point it comes to a state of rest or short-circuits the armature—burns it up.

Mr. Leonard: I should like to ask Lieut. Patten if he would kindly give us some description of the performance and sizes of the machines that he has made thus far?

Lieut. Patten: Those I have made are too small to give any data which would indicate any efficiency worth talking about.

Mr. Leonard: What voltage did you work upon?

Lieut. Patten: One hundred. I will draw the Mordey machine on the board and show the difference. (Fig 8 was placed on the board.) The device for rectification is fixed on the spindle of the moving machine. The dotted line represents the spindle of the machine. It is the commutator of an ordinary armature which is shown here, c. This being the armature circuit, we will trace it simply as a closed coil, A, from the upper point to the opposite point of the commutator, and thence to the field. On the same spindle with this armature is placed another commutator, which is shown here in two parts. The upper and lower halves, c_1 c_2, are separated by isolated segments connected to a rheostat such as I have described this evening. It is shown this way, but in reality there are for each pair of segments a corresponding pair of isolating segments connected with the rheostat, so that after the brush passes one segment it connects with the rheostat, and so on. At the bottom is the source of the alternating current. These terminals go to the two brushes, bearing on the rectifying commutator, which is broken up into alternating segments, part of them connected and part isolated. The live segments are connected alternately to two rings—say, one half to the segments of one ring and the other half to the other ring. Bearing on these rings are two brushes used as intermediate connections. Evidently this machine requires a speed of rotation such that the alternating current coming in at these two terminals will be commutated; then a direct current will flow from the brushes, bearing on the continuous rings, and from these brushes we have a direct current through the armature and field in series, back to the outer ring, and so returning to the source of the alternating current. This is spoken of by Leblanc as one solution of alternating current motors. It is not an alternating current motor in the strict sense of the word, because the alternating current is commutated before it is put into the machine. It is open to the same objection, of course, that the alternating current is broken at a point where it passes zero value, and the same remark applies to the field.

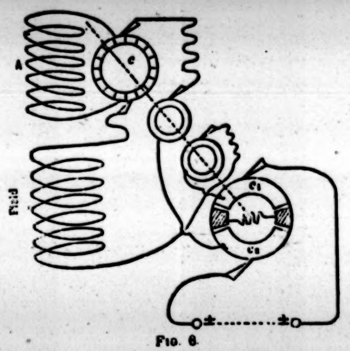


Fig. 8

Mr. W. Forman Collins: When you break the circuit there the field will lose its magnetism. Will not the armature act as a short circuit across the field?

Lieut. Patten: If the machine is in synchronism the current at this point is near zero, and the short circuit is then of little consequence.

Mr. Collins: It would induce very heavy sparking, would it not?

Lieut. Patten: It would if it were not for the isolating segments on which the brushes then bear, and which offer a path for the current and so prevent its rupture.

Mr. Collins: Provided the field maintains some little magnetism.

Lieut. Patten: Yes; if it gives it up entirely, of course the reactionary effect would produce sparking.

Mr. Charles J. Reed: I would like to ask one more question in regard to the action of these waves. As the potential varies from maximum to zero, suppose you have the normal speed; instead of being in reversal, the potential simply rises and falls from maximum to zero. Now, as that occurs at a certain speed, will not the iron completely lose its magnetism each time as the potential falls to zero? I confess I am not posted on the rate of demagnetisation of iron, but I am informed that in an ordinary converter the iron will actually become demagnetised something like 20,000 times a minute. I would like to get some information on that. If that is so, and you use a current having a less number of reversals than that, would not the magnetism actually become zero between each of those successive impulses or waves? Instead of being a continuous current, would not the current actually vary from a certain maximum to actual zero?

Lieut. Patten: I would suggest that you call upon others to answer these questions of general information. I would simply say in reply to that that so far as my experience is concerned I have seen magnets that change their magnetism as slowly as 15 times a second and retain enough to act as small dynamos; that is very slow as compared with 133 reversals which are used in this country, and down as low as 50 on the other side. But there undoubtedly is an approach to zero in the magnetic field, and there is at the same time a period of zero current in the armature. You can have an iron field that will not give up its magnetism in the one hundred and thirty-third part of a second, and you can have one that will give it up in much less time, and you can have one that will retain it one-fifteenth of a second.

Mr. Reed: Would not your laminated field be an objection, that it would tend to have the magnetism actually become zero at each reversal?

Mr. Mailloux: I think we can throw some light on this point. I do not think that the magnetism would necessarily come to zero, simply because we are not dealing here with a simple magnetic circuit. If we were dealing with a simple magnetic circuit in which there is no reaction against the lines of force in collapsing, then you would doubtless get a very quick collapse of the magnetism, and possibly absolute zero of magnetism in the interval between the two pulsations. You might explain this by taking an ordinary magnetic circuit—a ring for instance—with a magnetising coil, the ring consisting of very finely divided wire. Now, if there is no reaction (Foucault currents, &c.) against the flow of lines of force; if we assume the ring to be fully magnetised and the magnetism suddenly released, and if we even eliminate the self-induction of the magnetising coil itself, then we will readily see that the magnetism will fall almost instantly. There are experiments which go to show that the fall of magnetism would take place in an inconceivably small space of time under such circumstances. But if we interpose in the path of the lines of force as they move, while rising or falling, a closed circuit or some other form that would tend to produce reaction, then we get what we call "Lenz effects," and in that case we cannot get such a rapid rise and fall. Now, in this machine, the armature itself, the cord and conductors, are in the magnetic circuit; they form a part of it. Consequently at the time the magnetism is falling or rising, there would have to be considered the reaction due to the conductors wound around the magnetic field itself, and also the conductors wound around the armature, and the currents induced in these conductors by either the rise or fall, would necessarily tend to retard both the magnetising and the demagnetising process, and I should think that it would be possible to so regulate the self-induction of the different portions of the circuit as to control that. I, at first, thought that the demagnetisation would take place very rapidly. I still believe that there will be a great fluctuation, but I do not think that necessarily the magnetism would fall to zero, as further thought seems to indicate that although it would fall, yet it would probably come considerably short of absolute zero. There would be a certain amount of residual magnetism during the intervals between the current waves.

Mr. E. T. Birdsall: I think one point has been overlooked, and that is the action of different sizes of the machine. In small machines we know that in breaking the magnetic circuit, the magnet loses its power very quickly. In large machines of 20 or 30 horse-power it is known that magnets will not lose their magnetism for from two to three seconds, where the cores are very large and have a large amount of iron in them. In that case we might arrive at a mean degree of lamination, which would not produce too much heating. We might arrive at a size which would be a mean size of machine, and which would give the best effect. It also struck me, in regard to the magnetism falling, that possibly, although I have not thought it out, it does not matter so much whether the magnetism does fall, because everything else is zero at the same time the magnetism is zero.

The Chairman: There is one gentleman with us this evening who has had considerable experience in the manufacture of converters, and also in their use, who I think could enlighten us on two or three of the points which have just been raised, incidentally and directly. I refer to Mr. Gutmann. I think he might favour us with one or two practical remarks on the subject.

Mr. Ludwig Gutmann: I think the motor just described is a very ingenious one, but we cannot discuss the motor itself as it stands alone. We have, of course, to consider it in connection with the circuit, because we want to transmit power. Synchronous motors generally cannot be thoroughly successful, because they will not answer all purposes. The same speed is not required in all cases. This motor of course is a step forward because it can be so arranged as to permit the introduction of motors of different speeds on the same circuit. Nevertheless, the motor is of the constant speed type, while in practice a variable speed is often desirable. I see one serious objection to the motor, and that is that it has the high potential current in the motor armature itself, and in case of any trouble arising the consumer who has to handle it is immediately exposed to the danger of the medium or high-tension current in the main wires. That is the most serious trouble that I find with it. Otherwise I believe it would answer many purposes, because I think the motor will do its work well. It appears the motor would not start from state of rest with any load on it, and would need a loose pulley so as to get up to synchronism before the load could be thrown on. This, of course, would be a weakness, but not objectionable; but the first mentioned objection I think is a serious one—as the machine requires a high potential. I do not think that this motor can be worked with low tension currents, because, especially to produce three or four horse-power or more, the self-induction in those coils in connection with the mass of iron is great. If such a motor should be placed on an ordinary alternating current circuit used here now having about 1,000 to 1,500 volts, and there is any sliding connection and commutators to get loose, or brushes to wear out, we should always have to send practical and experienced men to the spot, and they are exposed to the thousand volt currents, and on this ground I do not see that it would quite answer the purpose—I mean that it would not be a solution of the problem, but a decided step in that direction.

Lieut. Patten: With reference to the point of high potential of the machine, of course in the general description I have given, the source of alternating current is represented as any source of alternating current of high or low potential, and so no special reference is made to its use as a high potential machine, on the direct mains from the station. The source of alternating current is presumably one of suitable character to meet the conditions in which it is to be used. With reference to the further difficulty mentioned, accidents will happen with any kind of machine, either direct or alternating, while the other forms of motor have some advantages in having ring contacts and sliding brushes that require no attention. The disadvantages that are introduced by bringing in the use of brushes are incident as well to the ordinary forms of motors with which we are familiar. We are not so familiar with the kind that have no commutators that we have got used to their ease and simplicity of working. The second set of brushes are not, as I said before, brushes in the ordinary sense, and do not require adjustment and care. If a high potential machine is used, of course the ordinary precautions will have to be taken. It is not quite within the province of the alternating current motor to make the alternating current safe for everybody who uses it.

Mr. Gutmann: I wish to point out that alternating current motors have this drawback, that the coils surrounding the iron core need a certain pressure to make any current flow through those coils—to get any power out of the motor we have to force the current through. Now to produce 5 or 10 horse-power we need an exciting power, we need a certain number of ampère turns in the field. To have this certain number of ampère turns we must have a considerably higher pressure than might be supposed. We must have an armature to perform the work and to obtain the torque. Consequently I think it is impossible to realise a large amount of power without using medium or high-tension currents for alternating current motors. Another point is that we have to consider that alternating current motors will not always be placed in the hands of scientists, but will have to be used by inexperienced men, consequently I think this is a weakness in the motor if we have loose or sliding connections in a high potential circuit. I should prefer to have a motor, for instance, like Prof. Thomson's, in which the high tension current is fixed—no rubbing contact—and I think Mr. Tesla has shown us one way in which to construct a motor without any aommutator or brushes, and I believe there are many electricians hard at work to get something similar without a commutator, which is far preferable, but we will have to wait some time before we shall get that. Anyhow Thomson, for instance, has given us a motor in which the field alone is in the high tension circuit. This is the main drawback that I find in this motor. If we had no rubbing contact in these motors, it would be a great advantage. As it stands, the armature is in series, or is in connection with the field, and consequently we have an increased self-induction, and we need a greater power and greater tension for this class of motor than we would if we had only to energise one of the two parts, either the armature or the field with the current, and that is the reason I said that there is a serious difficulty in introducing it into ordinary use.

The Chairman: There being no other speaker we should be glad to hear from Lieut. Patten in reply and in conclusion, though I think his replies have already been numerous and in most cases almost conclusive.

Lieut. Patten: I think the alternating current motor might be left for the present. In general reply to all it might be said that as to making a rival to the direct current motor, no attempt is made in that direction. The object is not to make a machine which has less weight and more efficiency at the outset than one that has been improved by the ablest talent of the world for the last five or six years. The question is radically whether or not we can make an alternating current motor at all. If we could, the question might be put, what are you going to do with your current 10 miles from here if you cannot get an alternating current motor? I think if the efficiency of such a machine drops to 60 per cent. it would not be a vital question in the problem with reference to the great importance of the transmission of power to great distances.

The Electric Light in Dundee Mills.—Messrs. Kinmond, spinners, have had the electric light installed in the whole of their large works, and on Friday evening last the entire place was illuminated for the first time.

ELECTRIC LIGHTING IN LONDON.

WORKS APPROVED BY THE COUNTY COUNCIL.

THE London County Council, at their usual weekly meeting at the Guildhall last Tuesday (the Earl of Rosebery in the chair), approved of various works proposed to be carried out by electric lighting companies.

Mr. A. H. HAGGIS (the chairman of the Highways Committee) submitted the report of that body, who stated that they had considered the following notices, given to the Council, of works under electric lighting orders, together with reports by the engineer thereon:—

"(a) Three, each dated 20th September, 1889, from the London Electric Supply Corporation, of its intention to lay distributing mains under the footways (1) in Trafalgar Square, Spring Gardens, Haymarket, Cockspur Street, Coventry Street (part of), Pall Mall East, Carlton House Terrace; (2) Pall Mall, Piccadilly (part of). St. James's Street (part of), Charles Street, St. James's Square, King Street (part of), York Street, Regent Street (part of), Haymarket, Duke Street (part of); (3) St. James's Street (part of), Piccadilly (part of), as shown upon a plan accompanying the notices.

"(b) 3rd October, 1889, from the Kensington and Knightsbridge Electric Lighting Company, of its intention to lay mains and straining-up and service boxes in certain thoroughfares in Knightsbridge and Kensington."

The committee stated that the works referred to in the notices of the London Electric Supply Corporation appeared to be unobjectionable, and they recommended:—"That the Council do approve such works, subject to the condition that the mains crossing the carriage-way of side streets be laid under the concrete."

This recommendation was agreed to without discussion.

The Highways Committee further reported that the Council on the 1st instant, on the committee's recommendation, signified its disapproval of the works referred to in two notices given by the Kensington and Knightsbridge Company. The principal cause of objection had now been removed, as with the present amended notice the company had sent in plans showing that the sizes of the straining-up and service boxes to be used had been considerably reduced. The committee recommended, and it was resolved:—"That the Council do signify its approval of the works referred to in the notice of the Kensington and Knightsbridge Electric Lighting Company, dated 3rd October, 1889."

NOTES.

Electric Lighting at Bournemouth.—The Bournemouth Improvement Commissioners at their last sitting had before them applications by three different electric lighting companies for the Commissioners' sanction to provisional orders which they sought to obtain from the Board of Trade, authorising them to supply electricity for public and private purposes in Bournemouth. The Clerk said he had written to the three companies asking for particulars and plans of their respective schemes, but only the House-to-House Electric Light Company had forwarded the information asked for. The question was again adjourned in order that the Lighting Committee might make enquires and report accordingly.

Electric Lighting at Cowes.—At the last sitting of the East Cowes Local Board, the Clerk reported the receipt of a communication from the Secretary of the Municipal Electric Lighting Corporation requesting the sanction of the Board to an application which the Corporation proposed making to the Board of Trade for a provisional order to supply Cowes with the electric light. Nothing was done in the matter.

Electric Lighting in Brisbane.—The *Queenslander* gives a short description of the installation at the Brisbane Newspaper Company's office. There are in use two of the Brush Company's Victoria compound dynamos, with an E.M.F. of 110 volts, one being capable of running 450, and the other 600 incandescent lamps of 20 candle-power. Everything seems to work well, and electric lamps are in use in every corner of the place. The lamps used are of the Swan type, but the holders are arranged to take either Swan or Edison lamps. A complete system of electric bells is also fitted up.

Electric Lighting at Hastings.—At a meeting of the Hastings Town Council on Friday, Alderman Hennah (secretary to the Local Electric Light Company) wrote asking for the Council's consent to an application to the Board of Trade for a provisional order, authorising the company to supply electricity in Hastings. The letter intimated that in the event of the permission being granted the application of another company would not be proceeded with. Councillor Jenner moved, and Councillor Bryant seconded, that the desired consent should be given. The motion was carried. Subsequently the Deputy Town Clerk stated that consent could not be accorded at that meeting, and the matter was eventually referred to the Council in Committee for consideration and report.

Electric Lighting in the Royal Navy.—On Friday evening a brilliant ball was given by the officers of H.M.S *Excellent*, at Portsmouth, to nearly 600 guests. The ship was lighted by close upon 400 small incandescent lamps in honour of the occasion, the installation having been carried out by the electrical staff of H.M.S. *Vernon*.

Reading.—At the last meeting of the Reading Town Council, the Highways, Streets and Public Lights Committee reported that they had considered the subject of arranging with Messrs. Laing, Wharton and Down, for the lighting of a district of the Borough with electricity, and thought it was not advisable to proceed with it at present, the chief reason assigned being that the entire subject of electric lighting, especially in relation to local authorities, was in a state of transition, and under the circumstances the supply of electricity to any district before statutory powers had been obtained was undesirable; moreover, nearly the whole of the regulations issued by the Board of Trade referred to matters not provided for in the agreement between the Corporation and Messrs. Laing, Wharton and Down, whose business appeared to be now carried on by a syndicate. The Council adopted the recommendation of the Committee.

Nottingham and the Electric Light.—The Town Council is about to apply for a provisional order for the lighting of the town.

Electric Lighting of Theatres.—The Metropolitan Electric Supply Company are now lighting the Gaiety, Garrick and Avenue Theatres.

Electric Lighting in the City.—Although there was a notice on the agenda paper of the City Commissioners of Sewers to resume the debate of the Streets Committee's report as to the tender for electric lighting, when the matter came before them on Tuesday last the special report ordered to be printed was not ready. The Chairman (Mr. George Manners), in answer to several of the members, stated that all he could say was that the report was not ready. He was assured by the engineer that it was impossible to have it printed in time for the meeting. After some further discussion it was decided that the debate should be again adjourned, and that when the report was ready the Chairman should appoint a special day for its consideration.

Electric Lighting at Bognor.—At the last sitting of the Bognor Local Board, Mr. Gregory asked what steps had been taken with regard to the lighting of the town by electricity. The Chairman replied that two companies had sent in notices stating their intention to apply to the Board of Trade for provisional orders to introduce the electric light into Bognor. He had long been of the opinion that the lighting arrangements of the town were very defective. They wanted more and better light, and that was only to be obtained, as far as he could see, by introducing the new illuminant into Bognor. Mr. Gregory concurred, and the subject was dropped on the understanding that the matter would be pressed forward.

A Sacred Spot.—Some dispute has recently arisen between the electric lighting company at Exeter and the Municipal Surveyor, owing to a proposal by the former to affix an electric lighting pole on the summit of the Guildhall. The borough surveyor has risen in arms against what he evidently regards as a would-be act of desecration, and suggests that the wires should be carried underground for a short distance, so as to obviate the necessity for anything of the kind.

The Electric Light at Exeter Theatre.—On Monday night the new theatre at Exeter, which has been erected from the plans of Mr. Darbyshire, of Manchester, was opened for the first time to a crowded house. As our readers are aware, the electric light plays a very important part in the interior economy of the new play house, which is thus the first among West of England theatres to adopt the improved mode of illumination. The installation has been carried out by the Exeter Electric Lighting Company, and passed with signal success the somewhat trying ordeal of a first night. The current comes from a couple of Mordey Victoria alternating current dynamos in the company's works, each capable of feeding 4,000 incandescent lamps. The Thomson-Houston system is used for the supply of arc lamps, and the two dynamos in use at the works are capable of supplying 35 arc lights of 1,200 C.P. each. On Monday night the lighting arrangements evoked universal admiration, some 350 incandescent lamps of 16 C.P. each being employed in the illumination of the stage. From the centre of the dome depends a fine 50-light electrolier, and the walls of the dress circle are adorned by 2-light copper and brazen brackets of tasteful and artistic design, while in the saloons use is made of 3 and 5-light pendants. The total number of lamps burning in the theatre is 510, and the whole of these are controlled by a group of switches placed on the same side of the stage as the prompter. On the whole the introduction of the electric light into the abode of the drama in Exeter is likely to add greatly to its popularity.

The Bradford Installation.—At the monthly meeting of the Bradford Town Council complaint was made that the firms who used the electric light could not obtain a supply except when the engines were running at night. The Chairman of the Committee intimated that instructions had been given to the engineers to run the engines on market days, and on days when the daylight was not good. A committee had been appointed to inquire into the use of accumulators. Their report would be ready before Christmas. The question of lighting the Town Hall and Art Galleries would stand over until the report was received.

The Hartlepools and the Electric Light.—The Corporation will apply for provisional orders for the supply of electricity for the borough.

Aberdeen Wants the Light.—The Town Council of Aberdeen has determined to apply to the Board of Trade for a provisional order for lighting a certain portion of the granite city by electricity.

The Electric Light at Scatwell.—The mansion of Scatwell, situated on the banks of the river Conon, about 10 miles from the Muir of Ord railway station, and belonging to Mr. W. J. Bell, has just been fitted up on the most complete scale with the electric light. The electricity is supplied by means of a turbine and dynamo situated about 200 yards from the house, and connected with it by cables laid underground. The work has been carried out under the direction of Mr. R. F. Yorke.

Electric Lighting at Paignton.—At this week's meeting of the Paignton Local Board, an application was read from the Electric Lighting and Power Company, Limited, asking for the sanction of the board to a provisional order which they proposed applying for from the Board of Trade, authorising them to supply electricity to the town of Paignton. The matter was referred to the lighting committee.

The Dover Corporation and the Electric Light.—At the meeting of the Dover Corporation on Tuesday, a committee was formed for the further consideration of the electric lighting of the town.

Telephonic Extension in Hampshire.—A few days since the trunk line connecting Southampton with Winchester was opened for the first time. A small party of gentlemen interested in the progress of telephony met at the Southampton office of the Western Counties and South Wales Telephone Company, and tested the working of the new line, which was found remarkably good. Mr. H. F. Lewis, secretary and general manager of the company was present, and gave a brief outline of the telephone movement in Southampton, there being now 102 persons at present connected with the exchange. Mr. Lewis went on to say that the company intended still further extending operations, and that it was hoped to complete the trunk line between Portsmouth, Gosport, Bournemouth, Poole, Southampton and Winchester considerably before Christmas. The line from Southampton to Winchester goes by way of Portswood, Swathling, Eastleigh. Otterbourne, and thence by the main road through St. Cross to Winchester. A three minutes' conversation is allowed for 6d. The company's trunk lines have met with unqualified success in Wales, as many as 30,000 messages being sent each month.

Antilles Cable Company.—Our readers will remember that the cables connecting Cuba, Hayti, Santo Domingo, Curaçoa and Venezuela were laid by the ss. *Roddam* in 1888, under a concession granted to the Compagnie Télégraphique des Antilles, of Paris. The concession relating to that portion of the system uniting Curaçoa with Venezuela has been lately transferred, by authorisation of the Govenor of the island of Curaçoa, to the Société Française des Télégraphes Sous-marins, of Paris.

Concession for Costa Rica Cables.—The Government of the Republic of Costa Rica has authorised Senor Don D. V. Cuenca Creus, concessionnaire of the proposed submarine cables between Venezuela and the United States, to establish direct or indirect telegraphic communication by means of one or several submarine cables with some point on the Atlantic coast of the Republic. The system may touch at one or several points in Central and South America which are as yet unconnected by telegraph on the Atlantic coast of Costa Rica. The concessionnaire binds himself to connect his system with the Atlantic cable which it is proposed to establish between Cuba, Spain and France, *viâ* the Canary Islands. The Costa Rica Government guarantees an annual amount of £1,400, and reserves to itself the right of intervening in the arrangement of tariffs and in the service regulations.

Italian Government Cables.—The submarine cable between Milazzo and Zipari, interrupted on March 30th last, was repaired by the Eastern Telegraph Company on April 5th. It would appear, at first sight, somewhat strange that this work should not have been undertaken by the Telegraph steamer, conjointly owned by the Italian Government and Messrs. Pirelli, of Milan. On April 1st last the Eastern Telegraph Company laid a new three-conductor cable across the Straits of Messina, between Bagnara and Torrebianca, to replace the one between Cannitello and Ganzirri, which broke down on February 16th last.

New Cable to the Argentine Republic.—In a previous issue we referred to the scheme, which has for some time been under the consideration of French and English capitalists, for directly connecting the Argentine Republic with Europe. In the last session of Congress the President of the Republic announced that a contract had been entered into with Messrs. Bieckert and Company for the laying of a cable between Buenos Ayres and Lisbon.

New Chilian Cables.—The Chilian Government some time since asked for tenders for the laying of a series of cables which are to connect the land line sytem at Port Montt (Melipulli) with the penal settlement at Sandy Point in the Magellan Straits. The little colony at Sandy Point will be familiar to most of our readers in connection with the loss, off that place, some years ago, of an English gunboat. Starting from Melipulli, the cables are to touch successively at Quincavi on the eastern side of the Island of Chiloë, at the Island of Zeones at the mouth of the river Piti-Palena on the mainland, at Melinka, a sealing station in the Guaytecas islands, at Port Otway on the peninsula of Tres Montes, at Munoz Gamero, a settlement in course of formation on King William IV. Land in the main channel opposite Larga Island, and finally at Sandy Point. One of the chief motives for establishing telegraphic communication with what are all but embryo settlements, is to facilitate the navigation of the straits, and to afford speedy relief to the crews of those vessels which may meet with misadventure during the passage through very dangerous and but partially surveyed waters. The recent loss in the straits, on a hitherto unknown rock, of a large mail steamer (one of several similar casualties) has, no doubt, aroused the Chilian Government to the serious consideration of the question of establishing telegraphic communication with the points above mentioned.

A New Atlantic Cable.—Notwithstanding the number of trans-atlantic cables at present existing there is in serious contemplation a project of placing Ostend in connection with some point in North America by means of a direct cable.

A Change.—Lieut. F. B. Badt has resigned his position with the Western Electric Company of Chicago, and accepted a situation with the United Edison Manufacturing Company.

American Conventions.—The United States Military Telegraph Corps held its ninth annual convention at Chicago on September 11th, papers being presented. The Old Time Telegraphers Association met at the same place on the same day.

City and Guilds of London Central Institution.—At the termination of the last session the John Samuel Scholarship was gained by A. E. Young, and the Siemens Medal for the student of greatest merit in the department of electrical engineering by C. G. Lamb. At the entrance examination for the new session, held this month, the Clothworkers' Scholarship of £60 a year, tenable for two years and renewable for a third year, entitling the successful candidate, in addition, to free education, was gained by A. C. Haycraft; the Mitchell Scholarship of £30 a year for two years, with free education, by F. H. Hummell; the three Institute's Scholarships, of sufficient value to cover the student's fees, each tenable for three years, by R. W. Weekes, H. E. J. Taylor, and E. G. Ingold; and the Public School Scholarships, entitling the successful candidates to free education, by R. L. Jenks and C. Mills.

Edinburgh Electrical Exhibition, 1890.—The Electrical Committee, under whose management the electrical branch of the exhibition will come, has now been constituted. It consists of the following gentlemen :—A. R. Bennett, General Manager, National Telephone Company; Principal Grant Ogilvie, Heriot-Watt College; Prof. G. F. Armstrong, Edinburgh University; J. Gibson, Superintending Engineer, Postal Telegraphs; A. F. Clement, Telegraph Superintendent, North British Railway; Dr. A. C. Elliott, Edinburgh University; D. A. Stevenson, Engineer to Commissioners of Northern Lights; Colonel Malcolm, Royal Engineers; J. Monteith, Carstairs House; G. Auldjo Jamieson, and Hugh Auld; the three last being gentlemen locally identified with the progress of electrical science.

Lecture on Electrical Transmission of Power.—On Saturday evening, Mr. Albion T. Snell, M.I.E.E. (Messrs. Immisch & Co.), delivered a lecture in the Mining School, Wigan, on "The electrical transmission of power as applied to mining operations." The proceedings were arranged by the Lancashire branch of the National Association of Colliery Managers, and in every respect they passed off very successfully. There was a large audience, the school being full of colliery managers, underlookers, firemen, and others interested in the development of mining matters.

Spray Arrester for Secondary Batteries.—The different methods which are now in vogue for preventing the nuisance occasioned by this cause are all open to more or less objections. Glass plates require constant cleaning, and only partially effect their object; liquid oil is damaging to the plates if they should at any time be removed; and paraffin wax run over the top renders the plates altogether inaccessible. The new method, patented by Messrs. Drake and Gorham, consists of floating particles of a light substance on the acid to a depth of about ¼ inch. This is perfectly harmless to the battery, and can easily be pushed aside to enable the plates to be cleaned when necessary. Another advantage claimed is that the cost is considerably less than for glass slabs or paraffin wax.

The Renard Battery Lamp.—Last year a patent was taken out by Major Renard for "improvements in, and relating to, electric batteries," consisting in the employment of chlorochromic exciting fluid in combination with silver electrodes platinised on both surfaces by lamination, and specially arranged. This battery has now been adapted to the purpose of a domestic portable lamp, which is being manufactured and sold by Messrs. Aron Brothers, of London and Paris. The lamp battery consists of seven glass cells, into each of which dips a pencil of zinc within a tube of platinised silver. These are enclosed in the pedestal of the lamp. The charging liquid is poured through an aperture in the cover of the pedestal, but when the charge is complete the liquid does not touch the zinc pencils. To bring the liquid up to the elements air is pumped into the vessel and the liquid is forced up into the glass cells. This is done very simply by means of an India-rubber ball, and the battery is set at rest by merely releasing the air by means of a tap. With the lamp is provided a glass jar and siphon for emptying the containing vessel. The height of the lamp is 33 inches, and the weight, when charged, 35 lbs. It is said to afford a light equal to 25 candles for from five to eight hours, the charge (consisting of chromic acid, muriatic acid, and sulphuric acid mixed with water) costing for each charge about two shillings. The pneumatic arrangement, although, perhaps, the owners of this battery may not be aware of it, is a very old idea, and was described and illustrated on page 269 of the ELECTRICAL REVIEW for July 1st, 1878.

Errata.—In the article "A Synthetic Study of Dynamo Machines" in our last week's issue near the bottom of the first column on page 381 read :—Starting from the commutator bar immediately under the right hand one, the current flows down C and up D, the end of the section being then joined to the adjacent bar. In the next section it flows down E and up F, then from G to H, and so on, half the winding finishing on the bar immediately above the one connected to O. The brushes rest on the two bars referred to.

Newspaper Articles on Electricity.—Mr. Thomas Helsby is contributing a series of articles upon this subject to the *Manchester Courier*.

Worcester and Electric Lighting.—The Town Council have decided to apply to the Board of Trade for provisional orders for the lighting of the borough.

Electric Lighting in Portsmouth.—The movement in favour of electric lighting, which has now become so general, is taking root in the South of England, and the new company which, as will be seen in another column, has been started at Portsmouth promises to assume the proportions of a very important undertaking. Some months have elapsed since it was first announced that a powerful group was being formed with the view of introducing an improved system of electric lighting into the borough; and as little further was said about the new project until a few days since, those who are interested in keeping up the present gas monopoly commenced to congratulate themselves that the threatened competition had fallen through. During the interval of silence, however, the promoters of the new company have not been idle, having been engaged in investigating the respective merits of the different systems of electric lighting, and in arranging a thoroughly satisfactory contract for the laying down of the necessary works and plant. As a result, the directors have just entered into a contract with the House-to-House Electric Lighting Company, Limited, for the construction of a central station, &c., at Portsmouth, under the supervision of Mr. Lowrie, who was the engineer engaged in connection with the Kensington station. The directors of the new company announce that they are fully satisfied that the system of working with alternating currents (which is about to be adopted for the electric lighting of Madrid, in which the House-to-House Company are largely interested), is far superior to any other. Some time must necessarily elapse before the new company can commence active operations; but notices have already been given of its intention to apply for Parliamentary powers, and as little time will be lost as possible. The names mentioned in connection with the new company constitute a sufficient guarantee that the want of local support, which has hitherto militated against the electric light in the largest and most important town of Hampshire, will not be felt in the present instance. The directors have, it is stated, good reasons to be satisfied with the support which has already been promised their scheme in influential quarters.

A Mutual Advantage.—Our readers will remember the long article which appeared recently in these columns regarding the electric light supplanting gas and the conclusions arrived at thereupon. The views we then expressed have now, in almost every point dealt with, been confirmed, even by the President of the North of England Gas Managers' Association at their half-yearly meeting held last Friday. Mr. Bridges, of Doncaster, stated that even if the electric light should prove successful, gas managers need not be down-hearted, as wherever the electric light had been introduced the demand for gas had increased. This was, he said, probably due to the fact that where the electric light was put up people, as a set-off, were more liberal in the use of gas, or they used more for cooking, heating, and motive power purposes. This is a very candid statement.

The Western Union Cable.—The *Financial News* says:—"A good many people in the City are wondering why the Gould cable, broken last November, has not been repaired. For nearly a year the Western Union has been working with one cable, and on September 11th the second cable broke, leaving the company high and dry. The repairing ship will not be ready to go to sea for another month, so that it will be a considerable period before the Western Union cables will be available for the use of the public."

Quick Cable Service.—The Mackay-Bennett Commercial Cable Company distanced all other competitors in transmitting to America the result of the boat race between Searle and O'Connor, which took place recently on the Thames. The news was known in Montreal about three minutes after the completion of the struggle.

How Lightning is Seen.—Mr. A. E. Brown, writing to *Nature*, gives an interesting description of a heavy thunderstorm which passed over Essex on the 2nd inst.; in many respects the accounts given by the observers afford instances of impressions which do not entirely accord with facts (a confliction which so often takes place). The special effects observed relate to the partial destruction of a windmill which was struck. The owner and a friend describes the effect as having the appearance of a mass of flame which threw off thousands of sparks, like fireworks, and after the flash a light appeared on the sail for a few seconds and the observers feared the mill would catch fire. Mr. Brown "considers it remarkable that the mill did not catch fire"; the splintered wood and cracked boards do not, however, at any attainable point show signs of charring. It seems more than possible that this and other cases of the same kind have been wrongly interpreted and that the effects observed are in the major portion due to an action on the optic nerve from the spectator himself receiving a shock. If we place pieces of zinc and copper above and below the tongue and intermittently join the free ends of the metals, each time this is done a flash appears to pass before the eyes of the experimenter, an effect due, as is known, to an action on the optic nerve. Probably if the spectators in the case in question could have been shielded from the electric influence, and, further, if the eyes had been shielded by a darkened glass the particular impressions observed would have been considerably modified and the flame and spark appearances would not have been noticed. In no phenomena we believe are optical appearances more deceptive than in the case of lightning, which afford practically no information as to what actually takes place, the mechanical effects observed are really the only indications which can be accepted as indications of what has actually occurred. The conclusion which Mr. Brown draws (from the mechanical effects noticed), viz., that a building to be well protected should have a network of conductors, seems reasonably borne out.

Increase in the Price of Gas.—The good people of Barnsley are agitating against a proposed increase in the price of gas, which is threatened by the local gas company. This seems a favourable opportunity for devising some scheme for lighting the town by electricity.

The Junior Engineering Society.—At the inaugural meeting of the ninth session, to take place this evening at the Westminster Palace Hotel, Victoria Street, S.W., the Presidential Address on "Mechanical Engineering in Electrical Industries" will be delivered by Prof. John Perry, D.Sc., F.R.S.

The Leading Lights of Leeds.—The Leeds Town Council has decided to postpone the further consideration of the electric lighting report for a period of six months. This action has been greeted with strong comments from both the Press and the public. There is just cause for complaint. The sum of £10,000 was voted to the electric lighting committee for the purpose of experimenting, and enabling it to arrive at some satisfactory conclusion respecting the value of electricity. A fair start was made, and judging by the enthusiastic manner with which the subject was taken up, there seemed a good prospect of Leeds adopting the electric light. But the money began to be exhausted, and suddenly someone suggested that electricity was only in an experimental stage. The committee became frightened, which fright extended to the Council, and with quakings and shakings the scheme is practically abandoned. Electricity in an experimental stage, forsooth! how long shall this remain as an excuse and cloak for the refuge of ignorance and weak-kneed public spirit? Truly, the members of the Leeds Town Council "have burned what they adored, and adored what they would have burned."

Projected Electric Tramway for Bournemouth.—At the last meeting of the Bournemouth Improvement Commissioners letters from Messrs. Harrison and Robinson, on behalf of Messrs. Haynes, were read with reference to the application for the sanction of the Commissioners to an application about to be forwarded to the Board of Trade, asking for a provisional order authorising the construction of a proposed electric tramway between Poole and Bournemouth. The proposed tramway practically does not enter into the town of Bournemouth. The Clerk said that the Board would not be able in any case to grant their permission, as no special notice had been given. The Chairman hoped that tramways never would enter Bournemouth. Mr. Hankinson said the plans deserved the most careful consideration. Perhaps a tramway on the very edges of the town might be beneficial in bringing business to it. The matter was eventually referred to the Roads and Works Committee, and that in the meantime the necessary notice should be given in case they might feel inclined to do so when it again comes before them.

Obituary.—We regret to learn of the sudden death, on October 3rd, of Mr. William Henry Sach, Telegraph Superintendent G.E.R., at the age of 60 years. Mr. Sach was probably known to but few of our readers, for of late years he had not come prominently before the electrical fraternity.

Paris Exhibition Awards.—The Compagnie Générale des Lampes Incandescentes of Paris has been awarded a gold medal for their exhibit of "Edison-Swan" lamps. We omitted in the list given last week the names of Messrs. Laing, Wharton and Down, as representing the manufacturers of "Okonite" wire, who were awarded a gold medal, and the Thomson-Houston Company, which received a Grand Prix.

The Electrical Accessories Company.—We notice that a company under this title has been formed to purchase the stamping works of Messrs. Atkins, in Hockley, Birmingham. Mr. Atkins, who is employed as works manager, has been actively engaged for many years in manufacturing those Birmingham stamped goods, which it is known are sold at surprisingly low prices. It is intended to manufacture the Atkins universal shade-holder, which is already being used in considerable quantities, switches, fuses, and all accessory electrical apparatus which can with advantage be stamped out. The advent of such a company should be of real service to contractors, as they will be able to obtain a serviceable article at a considerably lower price than at present.

Devonshire Club.—This building is being entirely redecorated, and is to be lit by some 300 lights. The contract is in the hands of Messrs. Drake and Gorham, and an effort is being made to introduce a new style of lighting to that which is usually employed for clubs, the object being to produce a soft light at the points required without the lamps being visible.

Sale of Machinery.—On Tuesday next and three following days Messrs. Wheatley Kirk, Price & Goulty will sell by auction, at the works at East Greenwich, the valuable plant and machinery of Messrs. Appleby Brothers, Limited (in liquidation). The catalogue contains many items worth the attention of electrical engineers and others.

Ransomes, Sims and Jefferies.—We have received from this company a copy of the new edition of their catalogue of steam engines and machinery (engineering section), containing alterations in prices, dated September 16th.

Change of Name.—The Globe Electrical Engineering Company, having taken up the sale of artistic electrical fittings, have determined to change their designation to the Globe Electrical and Art Fittings Company.

American News.—Mr. Alexander M'Adie, M.A., sends us the following letter from New York, which we are glad to publish, together with our own protest against the want of care evidenced by the correspondent to whom Mr. M'Adie refers. From the references sent to us it is evident that he was entirely misrepresented:—"Your correspondent who writes under the caption of 'Das Telephon' evidently does not take the trouble to verify statements which he may read in cheap and sensational newspapers before embodying them, without quotation marks, in his correspondence. In the ELECTRICAL REVIEW, August 16th, 1889, p. 193, is given what purports to be an account of an investigation held in New York (nearly 200 miles away from your correspondent's place of writing) on the subject of *thanetelectrisis* (killing by electricity). The account as given is most distorted, one-sided and untrue; but I care only to call attention to this statement: 'This Mr. M'Adie is employed by the Bell Telephone Company as a detective, hence his high opinion of Professor Silvanus P. Thompson.' I am not a detective, and am not employed by the Bell Telephone Company in any capacity whatever, nor have I ever been. As to whom I am the accompanying note should explain."

The Globe Carbon Company of Cleveland, U.S.A.—The carbons manufactured by this company are now to be obtained in this country from the Standard Time Company, Queen Victoria Street.

Telegraphic Communication at Torquay.—Great dissatisfaction prevails at Torquay with regard to the very limited telegraphic facilities which are provided there as compared with other towns. As was reported in the ELECTRICAL REVIEW at the time, the Local Board made a representation to the postal authorities on the subject, and an answer has now been received to the effect that the number of messages likely to be dealt with is not nearly large enough to warrant the department in incurring the considerable expense which such an action would involve. The Local Board do not intend to rest satisfied with the Postmaster-General's reply, and are about to carry the matter further.

Telegraphic Communication Resumed.—The Postal Telegraph authorities notify that communication with all parts of the kingdom has been restored.

Strike in America.—We hear that 200 *employés* in the Edison electric light factory, at Harrison, New Jersey, have struck work in consequence of their wages having been reduced by 20 per cent.

Personal.—It was reported on Wednesday evening that the strength of Sir Daniel Gooch was rapidly failing, and that in the opinion of Dr. Pavy and Dr. Ellison, unless a rally should occur, the end could not be far distant.

New Lamps for Old Ones.—It is understood that Mr. Edison, during his recent visit to London, stated that he would shortly place on the market an incandescent lamp which could be retailed at less than one-half the price of the present lamps. He also affirms that for the same expenditure of watts per candle-power it gives 25 per cent. more light.

The New Scotland Yard.—The colossal structure on the Thames Embankment, which is to take the place of the historic building in Whitehall, known as "Scotland Yard," is to be furnished with a very capacious telegraph room, and it will be lighted throughout by electricity.

Derby and the Electric Light.—At a special meeting of the Town Council to be held on November 9th, a resolution will be moved that application should forthwith be made to the Board of Trade for a provisional order, empowering the Corporation to supply electricity for public and private purposes.

The Army Telegraph System.—On Wednesday afternoon Colonel Jelf, who lately commanded the Telegraph Battalion of the Royal Engineers, read a paper before the Aldershot Military Society upon "The Field Telegraph, and its Relation to Military Operations," Major-General Walker presiding. Colonel Jelf stated that the two divisions forming the Telegraph Battalion, assisted by their reserve, are calculated to be able to provide the *personnel* for a headquarters and eight sections, that is, for 800 miles of communication, the allowance for two army corps; while two sections, with 200 miles of telegraph, would be ready to start in 48 hours after the receipt of the order to mobilise. Each section carries only 20 miles, but its reserve of 80 miles, with all poles and apparatus, is kept ready packed at Woolwich, so as to be put on board transports at the shortest notice.

The Graphophone.—A gold medal was awarded by the Paris Exhibition Jury to the Volta Graphophone Company, of Washington, for Tainter's admirable invention of engraving sonorous vibrations on wax cylinders.

Electrical Execution.—We hear that Wm. Kemmler, after all, is to be executed by electricity; the execution will probably take place in a few days.

Recent Interruptions and Repairs to Submarine Cables and Land Lines up to 25th September, 1889:—

	Interrupted.	Repaired.
Land line, Moulmein-Bangkok	15 June, 1889	17th June, 1889
„ „ „	20 July, „	22nd July, „
„ „ „	3 August „	10th August, „
„ „ „	12 „ „	16th „ „
„ „ „	6 Sept., „	7th Sept., „
„ Saigon-Bangkok ...	3 July, „	8th July, „
„ „ „	9 „ „	11th „ „
„ „ „	14 „ „	19th August, „
„ Indo - European South of Teheran	27 May, „	28th May, „
Cable, Ceara-Maranham ...	27 „ „	31st „ „
„ Maranham-Para ...	21 „ „	4th June, „
„ San Juan del Sur-Panama	3 June, „	4th „ „
„ San Juan del Sur-Panama	29 July, „	7th August, „
„ Trinidad-Demerara ...	23 May, „	6th June, „
„ Rio Grand do Sul-Monte Video ...	11 June, „	27th „ „
„ Assab-Massowah ...	13 „ „	18th „ „
„ Mossamedes-Cape Town	1 July, „	7th August, „
„ Anglo-American-Brest-St. Pierre	18 „ „	6th Sept., „
„ South of Chorillos ...	19 „ „	25th July, „
„ Pernambuco-Bahia ...	20 „ „	27th „ „
„ Australia-New Zealand	9 Aug., „	20th August, „
„ Gibraltar-Tangiers ...	10 Sept., „	23rd Sept., „
„ Western Union-Atlantics	12 „ „	Still interrupted.
„ Milazzo-Zipari ...	14 „ „	23rd Sept., 1889
„ Rio Janeiro-Bahia ...	3 „ „	18th „ „
„ „ „ „ ...	21 „ „	Still interrupted.

Captured by Telephone.—An important capture was made at Devonport last week, thanks to the telephone. It appears that a valuable hunting watch, worth £60, was stolen at Redruth, and information of the robbery was promptly circulated among the police for some miles around. About half-past 6 on the following evening a man entered the shop of Mr. Clarke, at Morice Town, and offered a watch in pledge for £2. The man bore a suspicious appearance, and Mr. Clarke had him detained while he ran to the police station, which has just been connected with the Guildhall by telephone, and obtained through the wire a description of the stolen watch. This tallied with the watch which had just been offered him, and he took a constable back to the shop with him, and instead of handing £2 over to his would-be customer, gave him into custody.

Cheap Telegrams.—The Hungarian Board of Trade is introducing a tariff for telegrams at the rate of ten words for a penny.

Electrical Trades Union.—A meeting of electrical engineers and linemen was held at the Paul's Head, Finsbury, last Saturday evening, to inaugurate a society on the trades union principle. The workman who was voted to the chair wished his name to be suppressed in view of the consequences which might ensue with his employers, and for politic reasons the names of other speakers were similarly withheld.

NEW COMPANY REGISTERED.

Hayle Gas Company, Limited.—Capital £10,000, in £5 shares. Objects: To manufacture and supply gas, electricity, or other illuminating agent, to the town and neighbourhood of Hayle, Cornwall. Signatories: Edward Bosse, R. E. Hodge, *J. Bazeley, J. Mudge, 20 shares each; *G. A. B. Pearce, 40 shares; B. Spray, T. G. Collings, 10 shares each; all of Hayle and neighbourhood. The first directors are the subscribers denoted by an asterisk, and Messrs. E. T. Bolitho, H. E. Harvey, E. Rosewarne, and J. Vivian; qualification, £100 in shares or stock; the company in general meeting will determine remuneration. Registered 2nd inst. by Waterlow and Sons, Limited, London Wall.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ruston, Proctor and Company, Limited (agricultural, mechanical and electrical engineers).—An agreement of 10th July between the North of England Trustee Debenture and Assets Corporation, Limited, and the Debenture Corporation, Limited, hereinafter called the vendors of the one part, and Richard Brutton, of Manchester, as trustee for this company, was filed on the 30th ult. It cites that by an agreement of 9th July the vendors agreed to purchase the business and assets of Ruston, Proctor and Company, but exclusive of property of Joseph Ruston in connection with the business carried on by him at Pesth, and exclusive of certain other property therein mentioned; the purchase consideration to be £465,000, and of that amount the sum of £125,000 to be payable by the allotment of £75,000 in fully paid shares, and £50,000 in debentures of a proposed company. This company will purchase from the vendors the property acquired by them under the agreement of 9th July for £500,000, payable £50,000 in debentures, £75,000 in fully paid shares, and the balance in cash. The said debentures are to form part of an issue of £250,000, bearing £5 per cent. per annum interest.

Woodhouse and Rawson, Limited.—At an extraordinary general meeting of this company held on the 6th ult., resolutions were passed to the effect that the company be wound up voluntarily, and that Sir John Stokes, Mr. Thomas Harrison Lambert, Mr. F. Ashby, Mr. Albert Hoster and Mr. F. Lawrence Rawson be the liquidators for the purpose of such winding up. The liquidators were also authorised to carry into effect the agreement of 15th July between this company and Woodhouse and Rawson United, Limited. The resolutions were confirmed at an extraordinary meeting held on the 26th ult., and were duly filed on the 4th inst.

Lancashire and Yorkshire Electric Lighting Company, Limited.—The annual return of this company, made up to the 22nd June, 1888, was filed on the 5th inst. The nominal capital is £100,000, in £5 shares. 127 shares have been taken up, and £2 10s. per share has been called thereupon. The calls paid amount to £315, and unpaid to £2 10s. The returns for 1886 and 1887 were filed on the same date. Registered office, 5, St. James's Square, Manchester.

Westinghouse Electric Company, Limited.—The registered office of this company, formerly at 105, Gresham House, is now situate at 4, Victoria Mansions, 32, Victoria Street, S.W.

Hamilton, Griffin and Company, Limited.—The registered office of this company is at 29, Essex Street, Strand.

Electrical Accessories Company, Limited.—The registered office of this company is at 66, Victoria Street, S.W.

Peru Telephone Company, Limited.—The registered office of this company is situate at 53, New Broad Street.

Ecuador Telephone Company, Limited.—The registered office of this company is situate at 53, New Broad Street.

CITY NOTES, REPORTS, MEETINGS, &c.

Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited.

THE first general meeting of the above company was held last Friday at Cannon Street Hotel for the transaction of the ordinary general business of the company, after which an extraordinary general meeting was held for approving a resolution, particulars of which are subjoined. Sir John H. Morris officiated as chairman.

The Secretary having read the notice convening the general meeting,

The Chairman said: Gentlemen, before making any observations, I wish to remind you that this is a meeting of the Foreign Elmore Company, and that it is only a statutory meeting, and our proceedings therefore will be somewhat of a formal nature. There will be no report to present, no balance sheet to present, and no accounts to be passed. At the same time I may inform you that all the shares offered for subscription to the public were more than applied for, and an allotment was made in full; also the calls have been regularly paid up to date, and there are no substantial arrears. Application has been made for a special statement and quotation for shares on the Stock Exchange, and as soon as we have made certain trifling alterations in the articles of association, for which a special meeting has been called at the close of this present one, we shall no doubt obtain what we have asked for. As this company has been in existence for some four months, you will probably wish to know what we have done, and what progress we have made during that period. I would remind you that this company has been formed for the purpose of acquiring certain patent rights for the various Elmore processes in foreign countries enumerated in the prospectus. It is not intended that this company should work such patents, but that it should resell the patents by the formation of subsidiary companies for different countries, and negotiations had already been commenced with a view of selling these patents. Now, as soon as the company was formed, the first steps taken by the directors were the acquisition of the various patent rights and certificates for foreign countries as stated in the prospectus. This was done, and the next step was to consider whether we should at once proceed to the formation of subsidiary companies, and to renew and carry out the negotiations which had already been commenced, or whether we should wait till the successful completion and carrying out of the Elmore processes by the English and home company, and proving by them the great commercial value of these processes to the satisfaction of the public. On going into the matter, we found that in almost all the applications and proposals which had been made to us for renewal of these negotiations were accompanied by conditions for various further trial tests and experiments before they were prepared to complete the negotiations or to conclude terms with us as to the amount they would pay for our patents. Now, I need scarcely inform you, gentlemen, that the existence of any such condition was tantamount to very greatly reducing the estimated money value of our patents if we had sold them then, whereas if we waited until the successful completion of the Elmore processes, we should not be tied down by any such hampering condition, but should be able to demand the full money value for our patents. We decided, therefore, after full consideration, that we would not for the present renew those negotiations or proceed to form any subsidiary companies, and in reply to a letter which we received from the principal parties interested in the renewal of these negotiations, we sent the following reply:—"That until the company is in a position to fully satisfy the public generally in regard to the value of the Elmore processes, the board must refrain from committing itself in any way in the matter of the sale of all or any of our patents, or to enter upon any exclusive negotiation to that end. At the same time, any specific and definite offer made for patents would have the consideration of the board." That was the conclusion we came to, and I hope you will approve and endorse our action in this matter, for I need scarcely tell you that had we proceeded, as I stated before, to reopen negotiations, we should have received a much smaller amount than we shall eventually. As we stated in the letter, we are open to any definite offer, which is a very different thing to entering into negotiations. No definite offer has been made; the object of negotiations, as far as I see, was to get us entangled and then get us to haggle over terms which would have necessitated us accepting a very low sum. We have no doubt ourselves as to the success, but we have still to prove it satisfactorily to the public. Experiments are at present being made on a gigantic scale. The experiments mentioned at the meeting of the Elmore Copper Company for England, held here a short time ago, were made in Paris on a somewhat small scale, at any rate much smaller than those we are carrying out. You will be anxious to know when we shall prove the success of the Elmore process. When this company was first formed we had every reason to believe that by this time we should have been in the position referred to, but unfortunately a few weeks after the formation of this company the erection of the building and plant was stopped by a strike amongst the workmen engaged thereon. The matter in dispute appeared to us to be very trifling, merely an increase of half-penny an hour in the pay of the workmen, and so impressed were the directors of the Elmore Company of the absolute necessity of preventing all possible delay in pushing on the work to the utmost extent, that they offered themselves to make up this difference provided the contractors would agree to the terms demanded by the workmen; but, unfortunately, the contractors would not agree to do so, and as there was a regular strike clause in the agreeemnt, the directors were precluded from exacting any penalty from the contractors for the non-performance of the work within the stipulated time. This delayed the work for at least six weeks, if not two months. It is now some weeks since work recommenced, and everything is now going on most satisfactorily. We hope in a few weeks the building will be erected, and the process completely carried out to the full satisfaction of the public, and the demonstration of its great commercial value. Of course, as soon as this is done, we shall be in a position to renew negotiations, and to form, as stated in the prospectus, subsidiary companies, and to obtain what we wish in the interests of all, the full money value of our patents. There is only one other point; we have received applications or proposals from eight or nine different parties for renewals of negotiations for the sale of patents in the following different countries—France, Belgium, Italy, Spain, Switzerland, Germany, Canada, United States and Sweden, and I have no doubt when we are ready to state the amount we are prepared to take, we shall receive many more reliable applications. If any questions are asked, I, or some other of the directors will be very glad to give any information in our power.

No questions being asked, the business of the special meeting was then proceeded with, which was the alteration of the several clauses of articles of association.

A vote of thanks to the chairman concluded the proceedings.

The Electricity Supply Company for Spain, Limited.

THIS company, with a capital of £100,000, has been formed primarily for the purpose of erecting a central station in Madrid under a valuable concession granted by the Municipality of Madrid. Senor Don Pedro, Pastor y Landero of Madrid, is appointed managing director in Spain; and Mr. F. C. Phillips, Assoc.M.Inst., C.E., engineer of the company. It is intended, after the successful lighting of Madrid, to extend the operations of the company to other large towns.

Brazilian Submarine Telegraph Company.—The accounts of this company, subject to audit, show a profit sufficient to enable the directors to recommend a final dividend of 1s. per share, making with previous distributions a total dividend of 6 per cent. for the year ended 30th June, 1889, and also the payment of a bonus of 3s. per share, both free of income tax, which will amount to £26,000, being a distribution in the aggregate of 7½ per cent. for the past year, leaving a balance of £47,609 3s. 9d., of which amount £45,000 has been placed to the reserve fund, increasing that fund to £259,660 9s. 8d., and £2,609 3s. 9d. carried forward. Dividend and bonus will be payable on the 7th November next.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the weeks ending 27th September and 4th October, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were respectively £1,[illegible] and £1,604.

The Great Northern Telegraph Company, Limited. The receipts in September, 1889, £25,000; January 1st to September 30th, 1889, £203,200; corresponding months, 1888, £202,600; and of 1887, £197,720.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ending October 4th, 1889, amounted to £2,976.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month of September were £7,230.

THE BRITISH ASSOCIATION.

PURIFICATION OF SEWAGE AND CONTAMINATED WATER BY ELECTROLYSIS.

(*Read before Section G, Newcastle-on-Tyne, September*, 1889.)

By William Webster, F.C.S.

The increasing populations of our large towns has made the question of sewage purification a very pressing one, particularly in relation to the purity of our rivers, most of which unquestionably are in a serious state of pollution. The sewage question generally has become of such importance in reference to public health now and hereafter, that it is evident steps must be taken as quickly as possible to remedy the present condition of things, and to maintain as high a standard of purification as is compatible with the enormous quantities with which we have to deal.

It may be that the present scientific knowledge is not sufficient to entirely and finally deal with this question. We should, however, aim at as high a standard of purification as possible—it is of no use to try half measures—and, whatever the treatment may be, my contention is that the nearer Nature's action is approached, the nearer the solution of the difficulty. Any new process requires thorough investigation, and it is for this reason that my experiments have taken up so much time; the success of certain laboratory experiments having been made public quite eight months before I was able to start a series on anything like a working scale, and since that time my connection with other undertakings has rendered it very difficult for me to concentrate attention except for short periods at intervals.

The oxidation of organic matter can only be attained by one mode—chemical action—whether it be by filtration, the addition of chemicals, or by mechanical force represented by the electric current.

Sewage is a most complex compound, the component parts of which depend upon the water supply of a town, in some cases upon the rainfall and the industries of the locality. Householders and owners of factories would much assist local authorities in the end aimed at if they would disinfect their refuse before it passes into the sewers, thus one of the most objectionable features I have noticed in London sewage is the large amount of organic matter floating on the surface with an obnoxious odour. I am not quite certain of its source, but it is evidently of a nature that points to gas works or tar distilleries, also certain dyes and tan refuse which require more treatment than sewage itself. I know that the manufacturer is at a loss where to put his waste products, and it is an extremely difficult question for the public to solve; but it is a moral certainty that, if the sanitary authorities of our cities and towns have to purify their sewage, the taxpayer will decline to pay for the treatment of manufacturers' refuse when it is known that sewage alone requires very much less expenditure on purification than when it is mixed with complicated waste compounds of a chemical nature. The great object in view is to prevent putrefaction, and it may not be out of place to state the means of arresting it. The question is, what is putrefaction? Putrefaction is a spontaneous change common to all organic bodies when exposed to the air; the action is accompanied by the evolution of unpleasant gases, which are, for the most part, compounds of sulphur and phosphorous; it differs from decay as it is not oxidation; the presence of air is essential only at the commencement of the action, and not after it has fairly set in. Modern science teaches us that air may be the carrier of ova which induce the change. Any dry matter does not putrefy; intense cold prevents putrefaction.

The atmosphere acts mechanically by its power of removing foul vapours, and chemically by their oxidation.

Water—its action is largely mechanical. Thus in a river organic matter becomes separated, and oxidation takes place by reason of the air dissolved in it; showers of rain purify the air, and the molecules of water forming the rain act as carriers of oxygen.

The soil as manifested in our graveyards, the iron oxides in the soil acting as purveyors of oxygen, and owing to the porosity of the soil, causes the oxidation of putrefying matter. Intense heat and light also play important parts in disinfection.

Sewage farms can only be successful when the porosity of the soil is adapted for filtration, and when the area is sufficiently large for the work it has to do; but all sewage before being run upon the land should be treated so that secondary putrefaction cannot be set up.

The organic matter should also be disintegrated so that the pores of the natural filter shall not be blocked up by it when in a state of semi-solution. Greasy matters should be removed as they also have a tendency to block up the soil.

Before entering into the particular subject of my Paper, I must ask you to glance at the list of a few of the chemical processes which have been tried in various parts of the world during the last 120 years.

Name of Substances.	Inventor.	
Sulphate of iron	Deboissieu	1762
Chlorine	Halle	1785
Lime	Estienne	1802
Powdered charcoal	Giraud	1805
Chlorine and chloride of lime	Guyton Morveau	1805
Ashes	Chaumette	1815
Sand	Duprat	1818
Sulphate of iron	Briant	1824
Chloride of soda	Labarraque	1824
Waste chloride of manganese	Payen and Chevalier	1825
Sulphate of lime	Siret	1827
Animal charcoal	Frigerio	1829
Peat	Guibourt and Sanson	1833
Charcoal and calcined marl or river mud	Pottevin	1836
Sulphates of iron and zinc with tan and tar	Siret	1837
Earth, lime and waste substances	Rossier	1837
Peat ashes	D'Arcet	1840
Metallic oxides and carbon	Krafft and Sucquet	1840
Chloride of zinc	Sir William Burnett	1840
Schist coke	Hompesch	1841
Trade refuse, charcoal and ashes	Albert	1842
Powdered lignite	Jourdan	1843
Impure alum	Siret	1843
Sulphate of zinc, charcoal and clay	Gagnage and Regnault	1844
Persulphate of iron	Baronnet	1845
Schist coke	Du Boisson	1845
Chlorides of iron and zinc	Dubois	1846
Lime and precipitating tanks	Higgs	1846
Nitrate of lead	Ledoyen	1847
Waste salts of iron, lead, zinc, &c., with pyrolig matters, ashes, &c.	Brown	1847
Pyrolignate and perchloride of iron	Ellerman	1847
Impure chloride of manganese	Young	1847
Dried seaweed, lime, and sulphate of lime and zinc	Salman	1848
Peat charcoal	Rogers	1848
Charcoal, soot, mineral salts, &c.	Legras	1849
Spent tan, carbonised	Tarling	1850
Fresh bark, sulphate of iron, and peat charcoal	Angely	1850
Metallic sub-salts, as of iron alumina, &c.	Browne	1850
Milk of lime and collecting the deposit	Wicksteed	1851
Acids and metallic salts, and filtrations through charcoal, clay, peat, gypsum, &c.	Dover	1851
Lime, sulphates of alumina, and zinc and charcoal	Stothert	1852
Lime, magnesian earth, sulphate of zinc or iron, and vegetable charcoal	Gilbee	1852
Sifted ashes, breeze, or peat charcoal	Perks	1852
Sulphate of zinc, potash, alum and sand with waste tan, ashes, lime, soot, &c.	Pinel	1853
Metallic sulphates, metallic chlorides or charcoal and magnesian salts	Herapath	1853
Salts produced in working galvanic batteries	Dering	1853
Peat or bog earth containing salts or oxides of iron	Dimsdale	1853
Peat and other charcoal and chloride of sodium, &c.	Macpherson	1853
Animal charcoal, alum, carbonate of soda, and gypsum	Manning	1853
Magnesia and lime with sulphurous and carbolic acids	Smith and McDougall	1854
Lime and finely-divided charcoal	Wicksteed	1854
Boghead coke	Herapath	1854
Soft sludge from alum works with lime and charcoal	Manning	1854
Peat charcoal carbonised with oil of vitriol	Longmaid	1855
Alum schist or shale, and other aluminous minerals, with lime and charcoal	Manning	1855
Manganates and permanganates	Condy	1857
Superphosphate of lime with magnesia and lime	Blyth	1858
Sulphate of iron with lime in solution (recommended only), &c.	Letheby	1858
Spongy iron	Bischoff	1865
Iron finely divided in revolving cylinders	Anderson	1884
Iron sulphate	Named Ferrozone	1887
Aluminium sulphate		
Calcium sulphate		
Magnesium sulphate		
Silica		
Black oxide of iron		

It is, I fear, true that many of the methods enumerated, and most of those not enumerated have not only failed to meet reasonable expectations as to their physical and sanitary characters, but they have also proved in many cases costly failures; and it is a remarkable fact that claims have been made within the last five years in reference to sulphate of iron by itself, or in combination with other materials, as if it had only just occurred to the chemical mind that these substances ought to be tried. On reference to this list, you will notice that the first five, dating from 1762—1805, are practically identical with those of recent date. In 1843 alum seems to have been tried, and in 1857 manganates and permanganates; the latest development of sulphate of iron is under the name of ferrozone. It was while working with perchloride of iron as a purifier of sewage that I first learned the importance of iron salts in relation to organic matter, and it was in connection with this chemical and free chlorine gas that the idea of electrolysis suggested a possible mode of treatment of water contaminated with organic matter. Sulphate of iron has one great drawback—the production of sulphide of iron due to the organic matter combining with the oxygen of the salt. In nature we have iron pyrites known as the bisulphide of iron, which is produced by the de-oxidation of sulphate by organic matter. The sulphuretted hydrogen in sewage is entirely due to the same action on the sulphates contained in it, it therefore follows that sulphates should not be added as they only increase the nuisance instead of abating it. Sulphuric acid added to manganate of soda and run immediately into the sewage is sure to lead to objectionable reactions. The very fact of adding chemicals means adding water, thus, to a certain extent, producing a seeming purification. The following illustration will show this:—

Ten grains of lime added to a gallon of sewage in the form of lime water means the addition of one pint of water, it therefore makes an apparent purification of 12·5 per cent. by this increase of water. I have here a list of analyses taken from the Appendices of the Report of the Royal Commission on Pollution of Rivers. My experience being that lime produces after putrefaction if used alone or with sulphates, and if used in large quantities is also sure to set up after precipitation when the resulting effluent is run into river water.

I have already stated that putrefaction means sulphuretted-hydrogen. On the West Coast of Africa the water contains large quantities of sulphuretted-hydrogen, its formation being due to the presence of organic matter and sulphates. I believe I am right in saying that this particular portion of the African Coast is known as the Sailors' Death trap.

Of artificial disinfectants chromic acid is the strongest, sulphurous acid the weakest among mineral acids. Permanganates oxidise dead organic matter under certain conditions, but unless in very concentrated solutions, have little or no action on disease germs. Chlorine gas or oxides of chlorine are the most powerful disinfectants.

The fact that water is easily decomposed provided the current electricity is of sufficient intensity, and also that the effects produced are precisely in accordance with the chemical equivalents of the substances electrolysed is practically the explanation of the whole system; for the chemical changes that take place in sewage when it is electrolysed depend chiefly on the well-known action that sodium, magnesium, and other chlorides (which are always present in sewage) are split up into their constituent parts. Thus we have at the positive pole chlorine and oxygen set free, and these elements are liberated in a nascent state, a condition in which they are intensely active, so that the organic matter in the sewage is rapidly oxidised into inocuous compounds. So rapid is this action that, provided the sewage contains a sufficiency of chlorides, it is possible to produce a disinfecting fluid from it consisting of oxides of chlorine.

As mine is an artificial action I will take the two disinfectants which are formed in my process, iron oxides and chlorine. The first a purveyor of oxygen, the second in the form of hypochlorites or chloric acid, absolutely destroys organic matter living or dead. By using non-oxidisable plates, such as carbon for positive pole and iron at the negative pole, with a porous diaphragm between them, I am able to collect the component parts of the mineral salts; therefore at the non-oxidisable plate I obtain a solution of chlorine and oxide of chlorine, and at the negative plate I obtain ammonia, soda, and potash, which in their turn precipitate any lime and magnesium salts that may be present in the liquid. So strong is the action of oxide of chlorine that it is only one form of carbon plate that will resist disintegration.

My first experiments carried out in this manner were conducted with platinum plates, but the experience was that the cost of platinum put it out of the question, besides which there was a very slight action on the positive plate which distinctly pointed to its ultimate destruction, there being no precipitation of the matters in suspension. By means of an arrangement which consists of a porous pot with a non-oxidisable plate such as carbon for the positive electrode and iron plates for the negative electrodes, I am able to manufacture the before-mentioned solution of oxides of chlorine from brackish sea water or sewage. The water of the River Thames near Barking is admirably suited for this purpose. It is possible that an objection may be raised that the resistance of the porous pot to the electric current would be so great that the cost would render it an impossibility from a commercial point of view, but the very fact of using salt water balances the extra resistance caused by the porous diaphragm, and for every ampère of current that is used per hour I produce 18 grains of nascent chlorine, or an equivalent of the oxides of chlorine. My experience of nascent chlorine as a disinfectant is that about one-third of a grain is capable of disinfecting one gallon of London sewage (first removing the matters in suspension) and on examination the presence of nitrites is detected, which shows how far the oxidation has been carried. This action, combined with the treatment with iron plates, hereafter described, will, if carried far enough, absolutely eradicate all organic matter. And here it will be as well to mention that the resulting effluent must not have an acid reaction, otherwise fungoid growths appear on the surface after a few hours. The forms in which these apparatus are best applied on a small scale, with porous diaphragms, are as follows:—First, an outer vessel, which may be made of iron—the sides in that case acting as negative electrodes—and an inner vessel containing the carbon electrode. By means of a syphon connected with a reservoir or tank, containing, say, sea water or salt and water, the inner vessel can always be kept supplied with the the saline solution, and by an easy automatic arrangement it is possible to draw off a given quantity of disinfectant solution when formed. By placing an oxidisable plate in the same pot as the carbon, and connecting the two to the positive pole of the current, I can produce a hypochlorite or chloride of the metal used which will thus further assist the resulting action. The many uses to which these disinfectants can be applied I need not enlarge upon. Six small cells of the latest form of the Leclanché type are quite sufficient for producing the necessary power for making two or three gallons of the chlorite solution during the day, and they will last for several months without recharging, it being understood, of course, that they do not remain continuously in action. The apparatus on a large scale may be variously modified according to the strength of the solutions of chlorides acted upon.

By applying the current to a carbon filter as arranged for, fig. 1, I am able to oxidise the organic matter in water. The positive pole being the porous carbon block, the nascent oxygen produced in the pores of the carbon by the electric current absolutely destroys the organic matter; bacteria being killed and the filter block itself kept clean. The action of porous carbon by itself is due to its power of absorbing noxious gases and effecting their destruction by bringing them into contact with atmospheric oxygen, but it is absolutely essential that there should be a free supply of air; how much more active the action is when nascent oxygen, and even chlorine, are constantly supplied to the pores of the carbon by means of the electric current, can be easily imagined. As an example, the following analysis before and after action may be of interest:—

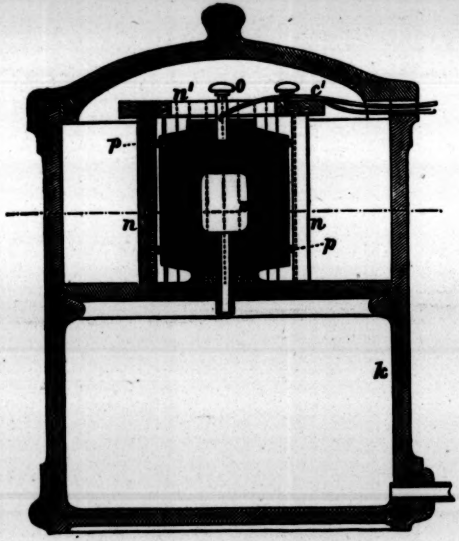


FIG. 1.—HOUSEHOLD FILTER.

c', show wires to batteries; m, positive electrodes; n, n, negative electrodes; p, p, non-conducting strips; k, containing vessel.

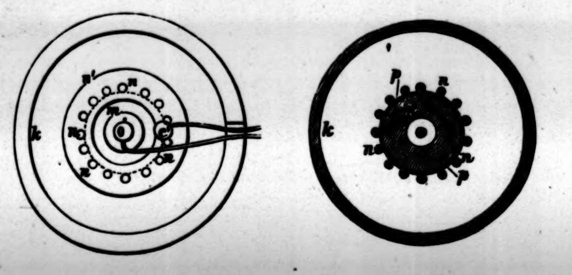
FILTER EXPERIMENT ANALYSIS.

Parts per Gallon.

—	Appearance.	Odour.	Oxygen required to oxidise the organic matter.
Before action—Dilute sewage...	turbid	bad	0·93
After action—Nitrites present	clear	none	·17
Before action—Contaminated water	slightly turbid	slight	·06
After action—Contaminated water	clear	none	·00
Before action—Dilute sewage...	turbid	bad	·82
After action—Ordinary carbon filter	slightly turbid	slight	·4
After action—Electric filter ...	clear	none	·13

Current used 0·5 ampère.

For the purposes of this filter, an ordinary form of stoneware, divided so that the lower compartment contains rather more than the upper, is used; a carbon block is fixed in the usual position and round this block two pieces of asbestos twine are tied; at the top of the block a platinised screw terminal is fixed, this forms the positive electrode. For the negative electrode, carbon rods are arranged so that they press on the asbestos twine, they are all connected together by means of a carbon disc at the top, also provided with a screw terminal, or, instead of the rods, a carbon cylinder may be used. All that is required is to attach these terminals to the respective terminal of a battery, consisting of three Leclanché cells, arranged in series. The action is automatic, as when the top compartment is full the battery is in action, when empty it is at rest.



FIGS. 2 AND 3.—SECTIONS OF HOUSEHOLD FILTER.

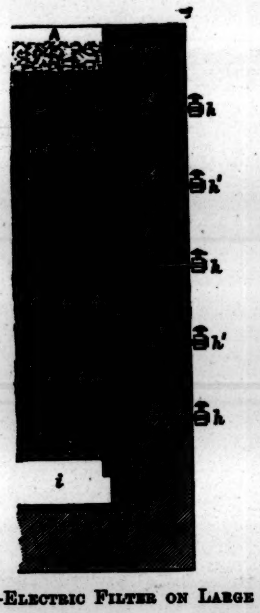


FIG. 4.—ELECTRIC FILTER ON LARGE SCALE.

Layers of Coke may be of any desired surface.

A, sand; B, tile with perforations or thin layer of sand; c, carbon electrode; f, coke; g', carbon electrode; h', carbon electrode; i, channel for filtered liquid to run out which may be filled with hoggin or large pebbles if desired.

On a large scale I have the filter arranged somewhat in the form of fig. 4, alternate layers of small coke free from sulphur are separated either by layers of sand or perforated tiles; by suitable connection these beds of coke form positive and negative electrodes. The first layer of material being sand so as to mechanically separate matters in suspension. It is impossible for disease germs to propagate owing to the nascent oxygen and chlorine produced when the filter is in action.

Another form is by embedding non-oxidisable plates in sand with or without porous diaphragms. The necessary electric current in this case would, of course, be taken from a dynamo. For the treatment of sewage it is absolutely necessary that precipitation of the matters in suspension should take place, and the more complete this is the better the ultimate result.

To produce this I employ oxidisable plates of such material that they shall have no poisonous after effects either on land or in rivers. The metals should be either aluminium or iron, but the first-named is out of the question owing to cost, and then iron, besides having the advantage as regards price, in the form of oxide has many valuable qualities, one of the chief being that sulphuretted hydrogen cannot exist when ferrous or ferric oxides are present. It is well known that oxide of iron in the hydrated form is largely used for purifying coal gas from sulphuretted hydrogen.

The electric action is easily explained practicably (experiment shown of action of small iron plates connected with a battery, two plates being positive and two negative; sewage acted on in cylindrical glass vessel). At the positive pole the chlorine and oxygen given off combine with the iron to form a salt which, I am persuaded is, for the moment, a hypochlorite of the metal, but it immediately changes into a chloride, which in its turn is deprived of chlorine to form ferrous carbonates and oxides. During the chemical action carbonate of iron exists in solution, and its formation is due to the presence of carbonates in the sewage, chiefly carbonate of ammonia. In samples that are absolutely free from dissolved oxygen, the ferrous oxide in the white form is precipitated, and on shaking up with air it changes to the usual pale green colour; the carbonate of iron at the same time being oxidised the ultimate precipitate is red, known as ferric oxide (Fe_2O_3), and I have noticed that sometimes this changes after a time back again to the ferrous state, FeO, thus showing that it has acted as a carrier of oxygen to the organic matter present. On a small scale the precipitate is carried to the top, due to the bubbles of hydrogen collecting round the particles of matter in suspension, but it ultimately sinks in the usual manner. In practice the precipitate does not rise, owing to the larger evaporating area, which allows the escape of the gases produced. The current required for the action varies with the nature of the sewage; but in this case I am using an ampère of current, and the amount of sewage is one-eighth of a gallon. It is usually assumed that 1·5 volts are required for splitting up water into its component parts; this may possibly be true with carbon plates, but with iron plates acting on sewage I can obtain the same result with ·9 volts as with double the intensity—of course, it takes a longer time, for with such a low voltage the quantity of current is small.

An ordinary sample of sewage requires, on an average, 1 ampère of current for 10 minutes per gallon, but when mixed with foreign matter such as manufacturers' waste products the amount required can only be estimated by experiment. The small plates I used in the experiment are of wrought iron; on a larger scale I use cast iron of the commonest "pig" quality, which is only one-third the cost and has the virtue of not scaling. Most of my experiments have been carried out with wrought iron sheet, which has the disadvantage of scaling, but on account of its lightness is more suitable for experimental work. The plates themselves should always be kept under water so as to prevent the formation of the red oxide on the surfaces, and the action should be continuous as far as possible, for if continuous the plates seem to acquire some property which reduces the resistance to the electric current, and therefore lessens the cost. At the beginning of a month's run which lately took place, the voltage measured across certain plates was three, but after a few days only 1·79, and doing the same work. On examining the plates freshly taken from the liquid they were in, I found a thin coating of the black, or magnetic oxide of iron, which has the property of preventing the rusting of the plate under water when the electric current is cut off.

For 1,000,000 gallons sewage flow, 24 hours, the complete plant necessary is:—Engine, dynamo, and boiler house; two engines and boilers, each 12 horse-power nominal; two dynamos, brick shoots with culverts at side, two settling tanks, sludge tank, sewage culvert, treated sewage culvert, cast iron plates, copper conductor, measuring instruments. Where the effluent has to run into a small stream or river a suitable tank would have to be constructed for arranging the electric filter as before described.

A channel is kept at the bottom of the electrodes for the silt to collect, with a culvert at side to flush it into so as to prevent any block occurring, but the advantage of this is obvious. The plates in each section are about an inch thick, and can be of any length up to 6 feet; it may be possibly objected that a large number of plates is required. This may be so, but the larger the number of plates the less the engine power required, and the longer they last. In each section the electrodes are in parallel, and any one section is in series with the other, the arrangement being exactly like that of a series of primary battery cells.

By actual experience I have been able to prove that at least 25 sections of electrodes should be in series, and across any one of these sections the potential difference need not be greater than 1·8 volts, the current being of any desired amount according to the surface of plates used. In experiments that were lately carried out I used a current of 370 ampères, which was calculated as ·23 ampère per gallon per hour; or, taking it in watts, the estimated horse-power required per million gallons in 24 hours was 23. The organic matter in solution of the particular sewage acted on on this occasion showed a reduction of 61 per cent. after treatment. The plates, even at half an inch apart, show no signs of blocking; the liquid to be acted on of course should be screened in the usual way and allowed to run through the plates as rapidly as the treatment required will allow, so that every molecule shall come into contact with the surfaces of metal. During a run that lately took place the measurement across the electrodes proved that 19 estimated horse-power was required to treat 1,000,000 gallons in 24 hours, the resulting purification of organic matter in solution amounting to an average of 50 per cent., the waste of the iron plates showing an average of two grains per gallon of sewage treated.

In putting down plates for the above quantity of sewage I should allow sufficient weight for five or ten years' consumption; what remained of this could be sold as "old iron" at the end of that time. One of the advantages of having the plates in series is that if anything goes wrong in any particular section it can easily be set right, the current being cut off during the repairs. The shoot containing the electrodes should be coated inside with some sort of asphalte, so as to prevent, as far as possible, any leakage of current to earth, the asphalte acting as a sort of insulator.

The highest efficiency would be obtained by using direct driving, provided that the engine is of first-rate workmanship, and the dynamo constructed to run at a comparatively low speed. This saves in transmission, and prevents any difficulty that might arise with belting. Consumption of coal under the best conditions may be taken to range from 1·8 to 2·5 lbs. per horse-power hour; the cost of fuel and iron varies so much in different districts, the prices in London being nearly double those near mining localities, that I leave the question of an accurate estimate open; discounting this, it may be taken that the capital outlay necessary for complete plant, and capable of dealing with the sewage of a small town, amounting to a flow of 1,000,000 gallons daily, would be about £6,000 or £7,000, the engines and dynamos being in duplicate, as I presume most engineers would agree they should be. The quantity of iron plates included in the above sum would be serviceable for ten years as far as one can foresee, and I am also assuming that the town, where this plant would be erected, has no appliances for treatment, such as precipitating tanks, &c.; where these are already in existence the cost would naturally be less. In reference to the cost per million gallons the same arguments hold good as to the situation of the town ruling the price. Since my first calculations were made the rise in the markets has increased the cost of working, but it can be arrived at by the average consumption of iron and the necessary horse-power. Thus: the daily waste of iron may be taken as 286 lbs. and the consumption of coal three-fifths of a ton; the labour required for working a plant of this description would be two shifts, two men to each shift.

By combining the treatment of sewage flowing between metal plates with the electric filter it is possible to produce any degree of purity required. In this case the sewage, after action with the iron electrodes, is allowed to flow into a settling tank, and after remaining there for an hour for the precipitate to subside the effluent, is passed through the filter, any oxide of iron that may be present tending to keep the top layer of filtering medium free from any objectionable action, and in turn forming a filtering medium. As the filter consumes no material, and does not require any additional engine power, for in using it the electrolytic action with metal plates not being carried so far, the cost of its working need not be considered. When a sufficient amount of oxide is deposited on the top layer of sand it can be removed, allowed to dry, and sold to gas works. The resulting sludge contains 6 per cent. of iron oxide, which does not represent the waste of the plates alone, for in London sewage the wear and tear of the tires of wheels, horses' shoes, &c., in the street means oxide of iron in its composition. One sample taken some months back contained no less than six grains of iron oxide in the gallon before treatment.

Sir Henry Roscoe has kindly consented to my quoting a few extracts from his report, and the analyses made by him during the investigation of this process. He states:—

"The quantity of sewage operated on in each experiment was about 20,000 gallons.

"The reduction of organic matter in solution is the crucial test of the value of a precipitating agent, for unless the organic matter is reduced the effluent will putrefy and rapidly become offensive. I have not observed in any of the unfiltered effluents from this process which I have examined any signs of putrefaction, but, on the contrary, a tendency to oxydise.

"The absence of sulphuretted hydrogen in samples of unfiltered effluents which have been kept in stoppered bottles for three weeks is also a fact of importance.

"The settled sewage was not in this condition, as it rapidly underwent decomposition in two or three days, even when in contact with air.

"By this process the soluble organic matter is reduced to a condition favourable to the further purification by natural agencies."

SIR HENRY ROSCOE'S ANALYSES.

Per Centage Reductions.

	Oxygen Required to Oxydise.	Albumenoid Ammonia.
No. 1.	67·4	57·0
2.	64·3	57·3
3.	77·2	75·0
4.	72·6	50·0
5.	76·5	87·5
6.	73·0	87·5

Another series of experiments carried out by Sir H. Roscoe, which I have tabulated, show an average reduction of 60 per cent., although the full treatment was not carried out.

I have also other lists of analysis by Dr. Meymott Tidy and Mr. Midwinter which show equally favourable results.

I have also tabulated analyses of my own carried out in 1886, showing the electrolytic action on contaminated canal water.

Here are analyses of samples taken from each section of the shoot, there being six in series. The organic matter is seen to be gradually reduced by the electro-chemical action.

I have never seen an effluent, treated in the way described, show any signs of secondary decomposition nor develop sulphuretted hydrogen.

In cases where specially prepared or suitable land of a porous nature is procurable the effluent might be wholly or partially used for manuring crops, in which case the sewage should be only so far treated that the prevention of putrefaction is assured.

The advantage of iron in the soil is one which, I think, every practical man must acknowledge. I had some sludge (deposit after electric treatment) pressed without the addition of lime, and it was applied to vegetables, the result being that a marked difference in favour of iron manure was shown in the crops when compared to others grown with ordinary farm-yard manure.

The question of sludge disposal is a difficult one, and as my paper is essentially electrical, I will only mention that I should, where practicable, puddle it with chalk, and run on to waste lands, through wooden conduits, similar to the process of mixing clay and chalk in a washing mill, and running into backs, as carried out in cement manufacture, the only alternatives being filter-pressing, or shipping out to sea.

The bacteria question is one which has probably still to be settled; but being anxious to have some information as to the action of the iron compound produced by electro-chemical decomposition, I had some experiments carried out, with the result that after a given treatment the whole of the bacteria were killed. In the case of experiments carried out in Paris, with ordinary treatment by means of iron electrodes, the results were as follows:—

	Raw Sewage.	Effluent.
Organisms per cubic centimetre	5,000,000	600

Another experiment in which the effluent was treated still further, so that a slight odour of oxide of chlorine was perceptible, destroyed all organisms, and the liquid remained sterile.

In conclusion, I submit that the application of the electric current in the several ways I have endeavoured to describe produces a precipitating and oxidising action similar to natural processes, in which the organic matter is destroyed by oxidation due to dissolved oxygen slowly absorbed from the air, assisted in many cases by matters in the soil, such as oxides of iron, acting as carriers of oxygen, and I also consider that the question of cost will bear favourable comparison with any process which really does the work attributed to it.

DISCUSSION.

Mr. J. SHOOLBRED: I have had an opportunity of seeing not long ago a number of experiments carried out of Mr. Webster's process, on a scale which might equal that of a small town. What we have seen this afternoon has shown very clearly that there is something at all events very well worth the consideration of sewage authorities, and an important question for towns, and especially as it will probably save the enormous amount of chemicals in the form principally of chalk and lime, which has to be imported at considerable expense. Experiments which have been carried out elsewhere point to the fact that it is an essentially practical question.

ON A NEW FORM OF CURRENT-WEIGHER.

By Prof. JAMES BLYTH, M.A., F.R.S.E.

(*Read September*, 1889, *before Section A.*)

IN the construction of balances for the measurement of electric currents a greater or less difficulty has always been experinced in leading the current into the movable parts of the instrument without seriously interfering with its sensibility. Several methods have been adopted to overcome this difficulty. In some balances the current is led in by mercury cups; in others, flexible leads, made of thin wire spirals or thin metal strips, are employed; while, in the recent balances by Sir William Thomson, the difficulty has been overcome by means of his well-known ligature suspension.

Some time ago it occurred to me that still another form of balance might be employed for this purpose, and the present paper is a short description of one which I have made.

The balance referred to is of the ordinary Roberval type, with the pivot connections all replaced by tightly stretched torsion wires.

It is constructed as follows:—

On a flat base board, fig 1, are placed two vertical uprights of wood or other insulating material, about six inches apart. Between these are stretched two parallel wires in the same vertical plane about three inches apart. To the middle points of these wires are soldered the two horizontal metal bars of the Roberval.

These are about nine inches long. Both horizontal bars terminate at each end either in forks or rings, placed in a horizontal plane, and wires are tightly stretched between the prongs of the forks, or across a diameter of the rings. To the middle points of these last wires are attached, also by soldering, the vertical bars of the balance, thus completing what takes the place of the ordinary jointed parallelogram of the Roberval.

The vertical bars have metal terminals, insulated from each other, and carry the circular discs, on the rims of which the movable coils of wire are wound. The bars pass at right angles through the centres of the discs, and are fixed to them at their middle points. The fixed coils, which are of exactly the same diameter as the movable ones, are supported from the base-board, and are placed so that one is about half an inch above one movable coil, while the other is as much below the other movable coil. From this it will be seen that when the balance is in equilibrium the fixed and movable coils are all horizontal, with a space of about half an inch between each pair.

The stretched wires may be either of steel or phosphor bronze, and before being finally soldered are placed under considerable tension.

The current flows through the instrument thus:—Entering, say, by the upper wire connecting the fixed supports, it passes to the upper horizontal bar. There it splits into two, one half (supposing the resistances equal) passing to each end of the bar, and, by means of the corresponding fork-wires, passing through the movable coils. From the movable coils each half returns along the lower horizontal bar and together pass out by the lower wire connecting the two main supports. From this the whole current passes first through the one fixed coil and then through the other, and in such a direction as to produce a repulsion between each pair of coils.

In the constructing care is taken that the suspended coils are both made of equal weight, and that when the balance is in equilibrium no torsion is in any of the wires. Small scale pans are attached to each vertical bar, and a bob for raising or lowering the centre of gravity of the whole is placed on a rod springing at right angles from the middle of one of the horizontal bars.

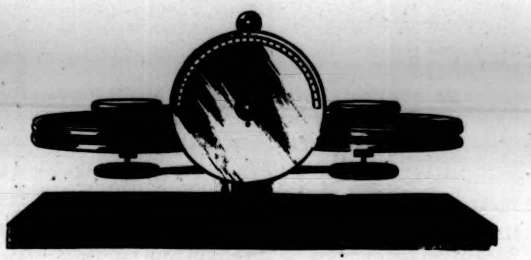


Fig. 1.

The current strength is estimated by the weight needed to restore the balance to equilibrium when disturbed by the passage of the current. A sliding weight may also be used as in a steelyard.

It will be readily seen that, as in all forms of current-weigher, the weights are proportional to the square of the current strength.

Another form of the instrument, which is in reality a torsion balance, is represented in fig. 2. It differs from the previous form in this, that all the coils are in a vertical plane with the torsion wires also vertical, while the current is measured by the number of degrees of torsion that must be given to one end of one of the torsion wires in order to bring the balance to equilibrium. If the connections be considered, it will be seen that no current passes through the wire whose torsion rigidity is used to measure it, and also that the current is so distributed among the other wires that only one-fourth of the heating effect is produced in each of them which would be produced if the entire current went through them. In this way the want of accuracy due to any heating of the wires is reduced to a minimum. The balance exhibited, though only a model, has a resistance of 360 ohms and is quite sensitive to currents of one-tenth of an ampere.

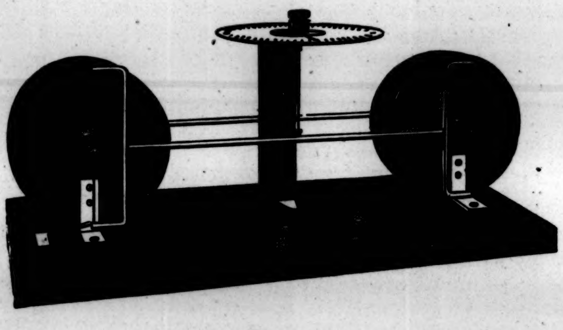


Fig. 2.

NEW PATENTS—

14971. "Improvements in secondary batteries." P. J. R. Dujardin. Dated September 23.

14991. "An electricity meter for alternating currents." O. T. Blathy. Dated September 23.

15045. "Improvements in electric switches and safety fuses for supply station distributing boards." C. M. Dorman and R. A. Smith. Dated September 24. (*Complete.*)

15155. "Improvements in the mode of storing and renewing the secondary batteries of electric tram cars." A. Dickinson. Dated September 26.

15230. "Improvements in electric batteries." Sir W. Vavasour. Dated September 27.

15246. "Method or means of regulating motor-dynamos or continuous current transformers." W. Lahmeyer. Dated September 27.

15248. "Improvements in electrical switches." C. H. Cathcart. Dated September 27.

15303. "Improvements in electric bells." W. Moseley. Dated September 28.

15308. "Improvements in driving dynamo-electric machines." J. A. McMullen. Dated September 28.

15311. "Improvements relating to telephonic apparatus." E. Jette. Dated September 28.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1888

10209. "An improved electric regulator." F. V. Maquaire. Dated July 13. 1s. 3d. Consists:—1. Carbon carriers actuated exclusively by a continuous current electro-motor capable of running in either direction. 2. An electro-metric balance actuated exclusively either by the principal current or by a current derived from the arc and controlling the setting in motion as well as the duration and direction of the motion of the electro-motor. 3. A safety coil whose function, in case of the accidental extinction of the arc, is, in the case of an installation in series, to short circuit the lamp during the time necessary for relighting it, or, in the case of installations in parallel, to maintain between the terminals of the lamp a fall of potential but slightly different from the normal fall, with the twofold object of protecting the lamp and of disturbing as little as possible, either when lighting or relighting, its proper action as well as the general working of the whole installation. 12 claims.

11897. "Improvements in or relating to apparatus for indicating the strength of current upon an electric circuit." O. B. Schallenberger. Dated August 7. 8d. The object of the invention is to provide convenient, effective and reliable means for determining the difference of potential existing between two given points in an electric circuit supplied with alternating, intermittent or pulsatory electric currents. It is well known that the value of a given electric current is proportional to the electromotive force to which it is due, divided by the resistance which it encounters. If, therefore, the resistance is decreased at the same time that the electromotive force is increased or *vice versâ*, then the current flowing will increase or decrease at a rate greater than the increase or decrease of the electromotive force. The present invention aims to substitute for such variable resistances a variable counter-electromotive force, the amount of which is dependent upon the variations in the difference of potential to be determined. A circuit having an appreciable self-induction, when traversed by alternating, intermittent or pulsatory electric currents opposes a counter-electromotive force varying in the manner required, for this purpose, that is to say, as the current traversing it decreases, the apparent resistance due to self-induction, diminishes, and *vice versâ*, although the actual specific resistance remains constant. 6 claims.

14622. "Variable adjustable resistance for electric currents." E. G. Craven. Dated October 11. 8d. Consists in winding the wire selected for the resistance in one continuous coil, and longitudinally upon a suitable frame composed preferably of slate or other non-inflammable and non-conducting material, a sufficient space being left between each convolution of said wire, and each end of said wire being attached to a suitable terminal or binding screw, mounted at convenient points on said frame. The short-circuiting or re-introducing in circuit of any desired quantity of the said continuous resistance wire is effected in the following manner: a suitable roller of non-conducting material is prepared of sufficient length, that when laid at right angles to the said longitudinally wound resistance wire, it will extend entirely across from side to side of the frame on which the said wire is wound. The said roller has a certain portion of its surface covered with a plate of sheet copper or other metal of high conductivity, the shape of said plate of metal being such, and its position upon the roller being so arranged, that on rotating the said roller upon the surface of the wires against which it is held by suitable supports and bearings, a larger or smaller surface of the conducting face or plate of the said roller is brought in contact with the resistance wire, according to the direction in which the said roller is rotated, thus short-circuiting or re-introducing in circuit such proportion of the coiled resistance wire as may be from time to time in contact with the metal face of the roller, or released from its contact therewith. 4 claims.

14703. "Improvements in apparatus for automatically regulating electric currents." P. W. Willans. Dated October 12. 8d. The inventor couples the cells in series one with the other through a succession of contact blocks conveniently ranged at a distance apart from one another, and in one method he employs a moving block or contact piece, coupled to one end of the line circuit, to be brought into contact with any one or other of the fixed blocks, whilst the opposite end of the line is coupled with one end of the series of battery cells, so that by moving the moving contact piece from one fixed block to the other, any number of cells can be brought into action. To automatically move the contact piece from one contact block to another, according to the strength of current in the circuit, he uses a solenoid coil or electro-magnet, through which a branch circuit is led from any two points in the line circuit at which it is desired to maintain a constant potential, or if it is desired to keep the current constant, he may take the whole or a part of the main current through the coils. The central moving core of this coil which, if a solenoid is arranged as in other electrical governors to be drawn in or out of the coil as the current varies in strength, he causes to impart motion through other mechanism to the moving contact piece. 4 claims.

14032. "Improvements in and connected with portable electric incandescent lamps and batteries." S. W. MAQUAY. Dated October 17. 8d. The inventor forms the battery of a vulcanite or other non-conducting casing, provided with two or more internal compartments for receiving the exciting liquid. Into each of said compartments extends an iron rod and a carbon plate or tube, these for convenience being attached to a head or top piece through which the electric connections are made, the carbon of one cell being attached to the iron in that next in order, an incandescent lamp being inserted in the circuit at one point. The exciting solution which it is preferred to use is composed of chromic acid, sulphuric acid, copperas and salt, suitably diluted with water. 3 claims.

15216. "Improvements in the construction of switches for the making and breaking of circuits conveying electric currents." C. M. DORMAN and R. A. SMITH. Dated October 23. 8d. Consists in adding mechanism connected directly or indirectly to the handle of the switch, whereby the pressure between the contact pieces is increased after contact has been made. The same mechanism ensures that the pressure between the contact pieces is decreased previous to the moment when the force of the spring or springs tends to move the contact pieces apart. The liability of the failure of the springs to break contact being thus overcome. 2 claims.

15324. "Improvements in the means for establishing electrical communication in railway trains." J. C. MARGETSON. Dated October 24. 8d. Consists in establishing continuous electrical communication from engine to vehicle, and from vehicle to vehicle in railway trains by means, or with the aid of, the vacuum brake pipes and their connections, the said electrical communication thus established being used either for working bells or for telephonic or lighting purposes, or for other purposes to which electricity can be applied in the train. The vacuum brake pipes, therefore, not only perform the ordinary work of brake pipes, but also, with their connections, serve to form, or assist in forming, electrical connection, so that free wires for this purpose can be dispensed with. The coupling together of the brake pipes establishes the electrical connection. 3 claims.

16140. "Improvements in the charging of secondary electric batteries from primary batteries and apparatus for that purpose." E. TYER. Dated November 7. 8d. Claims:—1. The described method of charging a secondary electric battery from a primary, by dividing the cells of the secondary battery into two or more groups, and causing them to be alternately switched into and out of contact with the primary at successive intervals of time so as to give the primary short periods of repose, and to give the charging of each group of the secondary cells short periods of intermission, for the purpose set forth. 2. For charging a secondary battery in the manner above referred to, in combination with a pendulum maintained in oscillation, two or more sets of contacts acted on by the pendulum so that alternately during part of each oscillation of the pendulum one group of secondary cells connected to one of the contacts is switched into circuit with the primary battery while another group is switched out of circuit, substantially as described.

18526. "Improvements in submarine telegraphic cables." J. C. L. LOEFFLER. Dated December 18. 6d. Relates to an arrangement of armour for protecting submarine telegraphic cables from the effects of ice so that the cable shall not be crushed or injured thereby. For this purpose the inventor strings a number of steel or other metal ferrules on the cable or on such parts of it as are liable to be damaged by ice, either inside or outside of its wire sheathing or in place of one of the wire sheathings. 1 claim.

ELECTRIC LIGHTING IN PADDINGTON.

A SPECIAL meeting of the Vestry of Paddington was held on Thursday, October 3rd, in the Vestry Hall, to resume the discussion on the following proposition of Mr. Mark H. Judge:—"That, inasmuch as the Electric Lighting Committee has not seen its way to recommend the vestry itself to undertake to provide electricity for lighting and other purposes in the borough, it is desirable that steps be now taken to secure it being done, at an early date, by private enterprise, under a provisional order approved by the vestry as the local authority."

The **CHAIRMAN** (Mr. Churchwarden Jackson) stated that Mr. Judge's proposal having previously been carried as an amendment to another resolution, it now came before the vestry as a substantive motion.

Mr. **CHARLES SEE** moved as an amendment: "That the whole question of electric lighting for the parish of Paddington be referred to a special committee of ten members for further consideration and report."

Mr. **CLARKE** desired to know, if they were going to discuss the question all over again, whether they should undertake the lighting themselves.

Mr. **SEE** then went into the reasons for referring the matter back. He thought that if the vestry could be convinced by plain unquestioned evidence that the charge for electric lighting would represent the charge for gas, and if the vestry could be assured that the statement of Prof. Forbes that it could be produced to supply the ratepayers at 4¼d., or even at 4d. if they had a large number to take the light, and if those two facts were really correct, then the vestry would be inclined to pause at least before it threw away the opportunities which were presented to them. He could not understand how, under the circumstances, the committee had come to the conclusion that, "taking everything into consideration, it would appear advisable for the vestry to entrust the work of electric lighting to a well established company." They did not give any reasons why they recommended the vestry to apply to some of the companies. Probably about £150 altogether had been spent in connection with the experts, and he did not think the committee were justified in bringing up a bald statement which assigned no reason why they should go against the opinion of the experts who had given the information to the vestry. They would have to rescind Mr. Judge's resolution before they could undertake to do the work themselves, and if the members would take a little trouble to go and see the different installations in London, they would see that the lighting might be made the means of a large profit being accumulated by the vestry towards the relief of the rates of the parish. Last week he went to the St. Pancras electric lighting station, and found that the cost came to precisely 6d. per light, or halfpenny per hour. So that so far as the cost of fuel—which was the principal item—was concerned in connection with the cost of arc lights, they could get one light at a cost not exceeding a halfpenny per hour, allowing the fullest margin for the cost of fuel. If they doubled that amount for labour, it would make it one penny; and that, he thought, was a really good margin. Then doubling it again for the interest and principle of that which was borrowed, they would find that they could get for two pence per hour one of the arc lights of 2,000 candle strength. If they asked one of the companies what one of the arc lights would cost, they would find it would come to considerably more than double that. Feeling that the report of the committee was at variance with the facts which had been gathered, he asked the vestry to refer the question to a special committee.

Mr. W. **CLARKE**: Are we going to reopen the question of whether the parish will do this work of electric lighting or not? I ask that, bearing in mind that 24 to 6 members said we were not.

The **CHAIRMAN** said that the amendment of Mr. See was perfectly regular and in order, and the question was a very important one for the vestry to discuss. Mr. See had given them figures and facts which were new. As to the 8 minutes' rule, to which his attention had been drawn, he thought the subject was so important, that it would be better not to curtail the debate.

Mr. Deputy-Surgeon C. M. **JESSOP** seconded the amendment.

Mr. **MINCHIN**, speaking in support of the amendment, expressed the opinion that if the vestry placed the lighting of the parish in the hands of a private company they would kill public electric lighting altogether. Mr. Judge had told them that he would oppose any scheme of electric lighting which would not supply the whole of Paddington, and thought that such a statement could only have arisen from an absolute misconception of the difficulties of the question. As to supplying electric light to private consumers, it was perfectly clear that neither a company nor the vestry could lay down their mains for the supply except in those quarters where the electric light would be taken and paid for. And, as a matter of fact, there were large portions of the Paddington district in which the light for private consumption would never be wanted. There were even many houses in the borough which did not use gas, although it was an advantage in the winter as it gave warmth as well as light. The electric light was absolutely without heat, and therefore gas had a great advantage over it for those who wanted warmth. The electric light would never be a competitor with gas for it was a luxury of the rich, and it was not everybody who could afford to pay for it. There could be no doubt that if the vestry handed over the necessary monopoly to a private company they would be absolutely depriving the ratepayers of an enormous boon which it was in their power to place in their hands.

Mr. **WILLIAM RAYNOR** said that on the important question of electric lighting there was not the slightest unanimity even among the scientists. They were not agreed as to the kind of electricity to be used, how it was to be used, or the price at which it could be supplied. If he could find a public body in London supplying their own light he might be disposed to favour the vestry doing so. The City was not prepared to recommend the authorities to undertake their own lighting, and the City not being prepared to undertake their lighting, he was not prepared to recommend the Paddington vestry to do so. There was not a parish more enterprising than Kensington, and they had deputed it to three companies. He concluded, by hoping that Paddington would entrust the lighting to a private company, and if they appointed a committee it should be as small as possible and chosen from among those persons who had some experience and scientific knowledge of the subject.

Mr. **JUDGE**, having read his resolution, said all parties ought to join together to get the fullest possible information as to the best terms and conditions under which the vestry could have the electric light supplied to them by private enterprise. If they afterwards ascertained that it would be much better to do the work themselves they could oppose the application for provisional orders, stating that they had definitely decided to do the lighting themselves. On the other hand, if they could get satisfactory proposals from any private company, they could support the provisional orders of the company which would then be sure of obtaining its orders, because the consent of the vestry was necessary unless the Board of Trade issued a special report giving reasons why it should not be granted. Mr. Minchin and Mr. See proved too much for their case. They said the vestry could not get electric lighting for the whole of the parish because no company could supply it; that the charges of the companies were so high; and yet they also said that if the vestry did it themselves they would make a great profit. If the vestry could make a profit the companies could make a greater profit. In conclusion, he trusted that the amendment would be rejected in favour of his resolution.

After further remarks by members, the proposal of Mr. Judge was then, as a substantive motion, carried unanimously.

Mr. **JUDGE** next proposed: "That it be referred to *an* electric lighting committed *of seven members* to prepare a draft provisional order by making such modifications in, and additions to, the latest model order issued by the Board of Trade, so as to provide as follows." Then the provisions A, B, C, D, E, F, G and H (given on page 362 of the ELECTRICAL REVIEW of September 27th) followed, and also the undermentioned provisions;—

"(I) That all conduits for conductors shall be of sufficient capacity for their being used for a system of fire alarms or other signals, and for this purpose the vestry to have the right to use the conduits free of charge.

"(J) That all stations for the production and supply of electricity be within the borough of Paddington, and the systems, both for public and private lighting, to be confined to the borough of Paddington, with the exception that, subject to the approval of the vestry, they may be extended to any part of Chelsea detached, and to such parts of other adjoining parishes as are within 100 yards of the boundary of Paddington.

"(K) Audit by the vestry, as the local authority, follows:—(From the Liverpool provisional order, 1889.) The local authority may from time to time appoint, or appoint and keep appointed, an auditor to audit the accounts of the undertakers, and the undertakers shall give such auditor, his clerks, and assistants access to the books and accounts of the undertakers, and shall, when required, furnish to him or them all such vouchers and information as he or they may require for the purpose of the audit, and shall afford to him or them all facilities for the proper execution of his and their duty. If such auditor shall be of opinion that the accounts are incorrect in principle or in detail, or that the provisions of this order with regard to the prices to be charged for the supply of energy to consumers or otherwise are not being complied with, he shall require the undertakers to correct the accounts in such manner as he may think right, and no dividend shall be declared by the undertakers until such accounts have been corrected to the satisfaction of the auditor, provided always that the auditor may by certificate authorise the payment of such interim dividend pending the correction of the accounts, as he may think fit. And provided also that if the undertakers shall consider any requirement of the auditor to be unreasonable or incorrect, then the propriety or otherwise of such requirement shall be settled by arbitration. If in the opinion of the local authority the amount at any time written off by the undertakers for depreciation or carried by them to reserve or depreciation fund is excessive, and the undertakers shall not, after notice in writing from the local authority, reduce such amount in accordance with the requirements of the local authority, the question of the amount to be carried by the undertakers to reserve or depreciation fund shall be referred to arbitration, and the arbitrator shall have power to direct any part of the amount written off or of the reserve or depreciation fund, as the case may be, which is in excess of the requirements of the case, to be applied in reducing the price charged by the undertakers for energy or otherwise, as he may think fit.

"(L) That the local authority shall, if it so desires, be entitled to purchase the undertaking at the expiration of 21 years and 31 years respectively.

"(M) Such other provisions as the electric lighting committee may direct, provided they are not contrary to, or inconsistent with the foregoing."

Mr. **JUDGE**, after explaining the various provisions, then proposed the following:—"That all references to the electric lighting joint committee be discharged, and that the electric lighting committee be authorised to consult the vestry solicitor in the preparation of the draft provisional order, and to advertise for proposals from companies and others for undertaking the supply of electricity under the conditions of the draft provisional order. All proposals to be sent in under seal, addressed to the vestry, to be opened by the vestry in the manner provided for the opening of tenders, and then to stand referred to the electric lighting committee for consideration and report."

Mr. **N. A. JEPHSON** seconded.

Colonel **BLAIR** said that the gentleman who would be able to give the committee the best advice would be a practical electrician.

Mr. **JUDGE** quite agreed that the committee ought to have the power to consult an expert—one who was a practical electrician—and he should be glad to adopt the suggestion.

Mr. **Clarke** hoped the committee would be empowered by the vestry to consult an electrical expert.

With the added words "a practical electrician" the resolution was carried.

The proceedings then terminated.

CORRESPONDENCE.

The Strike at Silvertown.

As misleading statements are being circulated with reference to a strike at our Silvertown factory, we ask you to give publicity to the particulars of weekly wages paid by us up to 14th September last, which will be found to compare favourably with those paid for similar work in any part of England :—

	Hours.	Pay.
Labourers (including yardmen and stokers)	63	26s. 3d.
India-rubber departments	63½	33s. 7d.
Cable, wire-covering, battery, gutta-percha, electric light and general departments ...	60	28s. 1d.

No able-bodied labourer employed by us received less than 4¾d. an hour. The above payments do not include those made to foremen, clerks, and skilled mechanics of various classes, who of course draw much higher wages.

We employ a considerable number of women and boys, who are not included in the above statement, but who are paid on a scale proportionate to that of the men.

The workpeople are practically in permanent employment, their weekly number not varying much during the year, and our workshops are large and well ventilated and lighted, and our appliances of the best.

Our factory is in the neighbourhood of the Docks, and the recent strike there appears to have unsettled the minds of some of the workpeople. The majority of them, however, have been intimidated into leaving their work, having when going to their meals to pass through a crowd who hissed and groaned at them, and used violent language. In some cases they have been hurt, but will not give evidence lest worse should befall them.

Yesterday about 115 women, who were satisfied with their pay, left work under intimidation ; and there are now about 1,600 workpeople thrown out of employment, leaving only 250 still at work.

Wm. J. Tyler, *Secretary.*

The India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.

October 4*th*, 1889.

Electric Surging.

Noticing in your last issue remarks on electric surging, I thought the following observations might be interesting to readers of the Review. I was working with a 200-volt Phœnix machine on a process in lamp manufacture technically termed "flashing," that is, thickening the filaments in a hydro-carbon—in this case cotton seed oil. If the filament be allowed to stand for a time in the oil, and then the current suddenly passed through it, the oil is suddenly heated and expanded, bursting the filament and suddenly interrupting the current. In almost every case I have noticed the current jump across the conductors (insulated cables), and for a time form an arc; of course it has been at some weak point in the insulation, but the potential must have been very greatly increased, for in no place was the insulation very weak, and at times the conductors were several inches apart. I had always put it down to self-induction caused by the very sudden interruption of the current.

S. Emerson.

Panorama Niagara, Bois de Boulogne,
Paris Passy, *October* 3*rd*, 1889.

Coal Consumption in Central Stations.

I have noticed in a recent number of your Review your reference to the high consumption of coal at Brighton, and I have read the comments upon this consumption made in the pamphlet issued by the Electrical Power Storage Company.

In that pamphlet it is stated that "This large consumption of coal is mainly due to the comparatively large amount of energy required by the primary circuit of alternating transformers when the secondary circuits are not being used at nearly the maximum capacity, a condition of affairs that must last about 20 hours in every day."

But I think it is fair to the transformer system to point out to you that the coal consumption of the Brighton station is exceptionally high in consequence of the inefficient method of transmission from boiler to dynamo by heavy shafting and heavy leather belts, and also of the old-fashioned and imperfect system of overhead wiring at Brighton ; and considering that the Brighton Electricity Supply station is the oldest in England, it is natural that the appliances connected with the delivery of power to the dynamo are old-fashioned. It would be much fairer to take as a basis the consumption of coal at a station laid down like that of the House-to-House Electric Light Supply Company at Kensington, on modern lines, where the boilers are all of most modern construction, and no shafting is employed. This station has been running too short a time to afford data upon a large scale, but I hope that in the coming winter it will be possible to lay before you results which will prove how thoroughly the Brighton consumption of coal points to a period that is past.

In the meantime I should like to know whether the figures given by the Electrical Power Storage Company respecting the consumption of coal per unit in their system are the result of estimate or of actual experience in a station, as nothing is mentioned in their pamphlet to enable one to form an opinion on this head.

Robert Hammond,

Chairman of the Brighton and Hove Electric Light Company, Limited.

October 5*th*, 1889.

Telephone Patents.

I am one of the unfortunate customers of the late lamented "New Telephone Company." As I have had to surrender my instruments to the United Telephone Company, and wish to substitute others, will you kindly give me your valuable opinion as to if I can legally use and fix the telephones now advertised, namely, Stanhope, Blenham's, Gilletts ; and do any of these instruments contain carbon transmitters or permanent magnets. Thanking you in anticipation for your advice.

For **H. M Edwards,**

H. B. Edwards.

October 8*th*, 1889.

[We will endeavour to answer our correspondent's queries in another issue.—Eds. Elec. Rev.]

Electric Traction Patents.

It would be advisable for Mr. William Houghton to read the patent specifications he refers to through again, and in doing so to observe more carefully. I would certainly advise my syndicate to enter an injunction to restrain anyone from infringing their patent rights, if it could be reasonably shown that these rights were being infringed.

A. J. Jarman.

October 8*th*, 1889.